TITLE OF THE INVENTION

COMMUNICATION-STATUS NOTIFICATION APPARATUS FOR

COMMUNICATION SYSTEM, COMMUNICATION-STATUS DISPLAY

APPARATUS, COMMUNICATION-STATUS NOTIFICATION METHOD,

MEDIUM IN WHICH COMMUNICATION-STATUS NOTIFICATION PROGRAM

IS RECORDED AND COMMUNICATION APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to a communication-status notification apparatus used in gateway equipment of a communication system, and a communication-status display apparatus used in a subscriber terminal connected to the equipment. The invention relates also to a communication-status notification method carried out in the communication-status notification apparatus, a medium in which a communication status notification program used in the equipment is recorded, and a communication apparatus having a communication-status notification mechanism.

2. Description of the Related Art:

In recent years, data traffic on various networks (e.g., office networks including telecommunication networks and data-communication networks) has increased constantly. Although being relatively small compared

with voice traffic (or audio traffic) in the past, the data traffic accounts for nearly 70 percent of the whole traffic on the present networks, and is expected to continue increasing in the years ahead.

5   Such a situation has formed the background to produce the concept of transmitting voice data (or audio data) via data-communication networks, thereby unify various kinds of networks into the data-communication networks so as to reduce costs. A technology that is
10   expected to embody this concept is Voice over Internet Protocol (VoIP).

VoIP is a technology of voice-data transmission using an Internet Protocol (IP) network, which is based on IP being a protocol for data transmission. More
15   specifically, VoIP enables to convert voice data into one or more IP packets so as to transmit the IP packets via an IP network, by means of equipment having a mechanism of converting various voice signals such as a telephone signal or a facsimile signal into IP packets, and vice
20   versa (hereinafter called a VoIP-gateway mechanism).

FIG. 22 illustrates a conventional communication system using the VoIP (hereinafter called a VoIP communication system). In the VoIP communication system shown in FIG. 22, a VoIP gateway apparatus 1-1, a VoIP
25   trunk 1-2, an Internet-telephony terminal 1-3 and an Internet-facsimile terminal 1-4 are connected to an IP network 9.

The VoIP gateway apparatus 1-1 is coupled to a public switched telephone network (PSTN) or an integrated services digital network (ISDN) to convert an analog or digital voice signal received from the PSTN or the ISDN into one or more IP packets, and vice versa. The VoIP trunk 1-2 is coupled to an exchange such as a private branch exchange (PBX) to convert a voice signal of the exchange into one or more IP packets, and vice versa.

Receiving various kinds of voice signals (e.g., a telephone signal, which was sent by a telephone, or a facsimile signal, which was sent by a facsimile machine) from the PSTN or the ISDN or via the exchange, the VoIP gateway apparatus 1-1 or the VoIP trunk 1-2 changes the voice signal into voice data so as to create one or more IP packets containing the voice data, and then sends the created IP packets into the IP network 9. And receiving one or more IP packets containing voice data from the IP network 9, the VoIP gateway apparatus 1-1 or the VoIP trunk 1-2 analyzes the received IP packets to extract the contained voice data so as to change the voice data into a voice signal, and then sends the voice signal into the PSTN or the ISDN, or to the exchange.

In short, each of the VoIP gateway apparatus 1-1 and the VoIP trunk 1-2 is provided with the VoIP-gateway mechanism to thereby serve as an interface between a terminal, such as a conventional telephone or a conventional facsimile machine, of an individual

subscriber and the IP network 9. The VoIP gateway apparatus 1-1 and the VoIP trunk 1-2 will be generically called VoIP gateway equipment in the following description.

The Internet-telephony terminal 1-3 and the Internet-facsimile terminal 1-4 are directly connected to the IP network 9 so as to serve as a subscriber terminal such as a telephone or a facsimile machine, and also have a function of converting voice signal such as a telephone signal or a facsimile signal into one or more IP packets, and vice versa.

Inputted various voice signals such as a telephone signal or a facsimile signal, the Internet-telephony terminal 1-3 or the Internet-facsimile terminal 1-4 converts the voice signal into voice data to create one or more IP packets containing the voice data, and then sends the created IP packets into the IP network 9. And receiving one or more IP packets containing voice data from the IP network 9, the Internet-telephony terminal 1-3 or the Internet-facsimile terminal 1-4 analyzes the received IP packets to extract the contained voice data, so as to change the extracted voice data into an optimum voice signal such as a telephone signal or a facsimile signal, and then outputs the resultant voice signal.

Each of the Internet-telephony terminal 1-3 and Internet-facsimile terminal 1-4 can be considered as a conventional subscriber terminal, such as a telephone or

-4-

a facsimile machine, to which the above-mentioned VoIP-gateway mechanism is added. Therefore, in the following description, each of the Internet-telephony terminal 1-3 and the Internet-facsimile terminal 1-4 will be considered as a combination of a mechanism of VoIP gateway equipment and a mechanism of a subscriber terminal formed as a single apparatus, and will be generically called a VoIP gateway terminal.

In short, VoIP is a technology in which VoIP gateway equipment is disposed between a subscriber terminal, such as a telephone or a facsimile machine, and an IP network, thereby enabling to transmit voice data contained in various kinds of voice signals, such as a telephone signal or a facsimile signal, via the IP network.

By putting VoIP to practical use, it is possible to transmit voice data via data-communication networks such as IP networks, thereby unify various kinds of networks into the data-communication networks so as to reduce costs. Further, concurrent transmission of conventional communication data and voice data carries an additional advantage of realizing various new services in which the communication data and the voice data are combined together.

Compared with the conventional technologies of transmitting a voice signal via a PSTN or the like, however, VoIP technology of transmitting voice data via

an IP network has also its disadvantages in voice communication on the following points:

① An individual subscriber is not provided with a dedicated connection line in the IP network. Each IP packet is transmitted across the IP network according to a destination address included in a header of each IP packet. A single link in the IP network would therefore allow various IP packets, directed to different destinations, to pass through.

② Traffic on the IP network is considerably affected by a kind of application program that each subscriber uses for communication and also by a number of subscribers concurrently connecting to the IP network for communication, and is therefore highly variable according to a communication condition and a period of time in which each subscriber connects to the IP network.

③ Voice-data transmission via the IP network involves creation/analysis process of IP packets (IP-packetization / IP-depacketization process), which increases a transmission delay of voice data.

④ Plural IP packets being in a single connection and having the same destination may take different routs in the IP network, owing to dynamic routing by routers in the IP network. Transmission delays of IP packets even in the same connection therefore vary for every IP packet.

Because of the above-described points, VoIP technology has some disadvantages in QoS (Quality of

Service), compared with the conventional voice
communication technologies.

Specifically the points ① and ② result in
degradation of voice data during the voice communication.
Heavy traffic tends to bring about a situation that too
many IP packets exceeding the processing capacity of
routers are directed to pass through the individual links
at once. This situation causes congestion of IP packets,
which results in disappearance of any IP packets, and
overflow of buffers of the individual routers, which
results in abandonment of IP packets subsequently
arriving at the individual routers. Such disappearance
or abandonment of IP packets can be fully recovered
during the ordinal data communication simply by sending
the disappeared or abandoned IP packets again, while it
affects considerably the voice-data communication, in
which immediate or simultaneous communication of voice
data is required, because it brings about the degradation
of voice data.

The points ③ and ④ result in delay of voice data
during the voice communication. The delay of voice data
is increased if the voice data undergoes audio CODEC
(code/decode or compression/decompression) processing in
the VoIP gateway equipment. Further, because
transmission routes of IP packets are unidentifiable in
the IP network, it is difficult to accurately estimate
the delay of voice data. Such indefinite delay of voice

-7-

data brings about considerable problem for the voice-data communication, in which immediate or simultaneous communication of voice data is required.

The communication via the IP network also brings about another problem. The Internet, being representative of various IP networks, is composed of a number of interconnected networks and terminals throughout the world. Connecting to the Internet therefore means connecting with the number of networks and terminals throughout the world via the Internet. It is therefore necessary to take adequate security measures for safe connection to the Internet. When a company's intranet is established so as to be connected to the Internet, for example, any security measures such as a firewall or a cryptographic processing would be taken ordinarily. Likewise, when voice VoIP communication system via the Internet is established, appropriate security measures are indispensable in order to prevent tapping or interception of voice data and to thereby ensure the security of voice communication.

Consequently, it is necessary to introduce various measures in respect with communication quality, such as QoS or security, in order to provide a satisfactory VoIP service. Several measures are proposed and actually adopted for ensuring communication quality. As a measure to ensure QoS, for example, it is proposed to apply UDP (user datagram protocol) or RTP (real-time transport

-8-

protocol), instead of TCP (transmission control protocol) commonly used, for use in combination with IP, or to apply RSVP (resource reservation setup protocol) to a layer higher than that of TCP/IP, thereby performing priority control of voice data or securing a bandwidth dedicated to voice data.

However, VoIP is basically a service of a best effort type and, therefore, has difficulty in always providing with the best communication quality to a subscriber, even if some technologies to improve the communication quality as described above are introduced.

Specifically, sudden decline of voice quality or sudden interruption of communication would prevent a subscriber from using VoIP communication without anxiety.

Likewise, regarding security measures such as cryptographic processing on voice data, a subscriber would find difficulty in setting/resetting an appropriate security process at the subscriber's request or in confirming security-processing status, thereby being prevented from using VoIP communication without anxiety.

In order to provide a subscriber with high communication quality as possible, it is necessary to provide a service in which the subscriber can observe a communication status in an IP network as the subscriber wishes, can select an appropriate condition of voice communication according to the observed communication status of the IP network as the subscriber requests, and

can confirm whether or not the IP network complies with the subscriber's request. However, such technology that enables a subscriber to observe a communication status of voice data in an IP network easily via the subscriber's terminal, such as a telephone or a facsimile machine, has not been developed.

SUMMARY OF THE INVENTION

With the foregoing problems in view, it is an object of the present invention to provide a communication-status notification apparatus, a communication-status display apparatus, a communication-status notification method, a recording medium in which a communication status notification program is recorded and a communication apparatus, which enable a user of a communication system, such as a VoIP communication system, to observe various kinds of communication status of voice data in a network, such as an IP network, easily via a subscriber terminal.

It is another object of the present invention to provide a communication-status notification apparatus that enables a user of the communication system to observe traffic status of voice data in a network easily via a subscriber terminal and, further, to select an optimum condition of voice communication according to the observed traffic status.

It is another object of the present invention to provide a communication-status notification apparatus that enables a user of the communication system to observe cryptographic-processing status in a network easily via a subscriber terminal and, further, to select an optimum condition of voice communication according to the observed cryptographic-processing status.

In the following description, a VoIP system (a VoIP communication system) is supposed as an example of such communication system. Also, an IP network (an IP communication network) is supposed as an example of such network (communication network) accordingly.

In order to attain this object, according to an aspect of the present invention, the communication-status notification apparatus for use in a VoIP (voice over internet protocol) communication system in which at least one subscriber terminal is connected to an IP communication network via first VoIP gateway equipment, serving for creating/analyzing an IP (internet protocol) packet as a voice data transmission medium, so that the subscriber terminal sends/receives voice data over the IP communication network, is adapted to be incorporated in the first VoIP gateway equipment and is equipped with a communication-status-notification management section for notifying the subscriber terminal of a communication status in the IP communication network via the first VoIP gateway equipment, based on a processing status of the

voice data in the first VoIP gateway equipment.

According to another aspect of the present invention, the communication-status notification apparatus for use in a VoIP (voice over internet protocol) communication system in which at least one subscriber terminal is connected to an IP communication network via first VoIP gateway equipment, serving to create/analyze an IP (internet protocol) packet as a voice data transmission medium, so that the subscriber terminal sends/receives voice data over the IP communication network, is adapted to be incorporated in the first VoIP gateway equipment and comprises: a request analysis section for discriminating whether or not voice data received by the first VoIP gateway equipment from the subscriber terminal contains a request on monitoring/controlling or notifying a communication status in the IP communication network, and for analyzing the content of the request contained in the voice data received from the subscriber terminal; a communication-status monitor/control section, responsive to the content of the request analyzed by the request analysis section, for monitoring/controlling the communication status of the IP communication network, based on the processing status of the voice data in the first VoIP gateway equipment; and a communication-status notification section, responsive to the content of the request analyzed by the request analysis section, for notifying

the subscriber terminal of the communication status monitored/controlled by the communication-status monitor/control section via the first VoIP gateway equipment.

According to a further aspect of the present invention, the communication-status display apparatus for use in a VoIP (voice over internet protocol) communication system in which at least one subscriber terminal is connected to an IP communication network via VoIP gateway equipment, serving to create/analyze an IP (internet protocol) packet as a voice data transmission medium, so that the subscriber terminal sends/receives voice data over the IP communication network, and also serving to monitor/control a communication status in the IP communication network so as to notify the subscriber terminal of information about the monitored/controlled communication status, is adapted to be incorporated in the subscriber terminal and comprises: a notified-information detection section for detecting information about the communication status of the IP communication network, which status is monitored/controlled by the VoIP gateway equipment, when the subscriber terminal is notified of the communication-status information from the VoIP gateway equipment; a display-material storage section for storing at least one of voice, character and image as display materials; and a communication-status display section for displaying the communication status

of the IP communication network, based on the communication-status information detected by the notified-information detection section, using the display materials stored in the display-material storage section.

According to a further aspect of the present invention, the communication-status notification method for notifying at least one subscriber terminal of a communication status in an IP (internet protocol) communication network of a VoIP (voice over internet protocol) communication system in which the subscriber terminal is connected to the IP communication network via VoIP gateway equipment, serving to create/analyze an IP packet as a voice data transmission medium, so that the subscriber terminal sends/receives voice data over the IP communication network, is carried out at the VoIP gateway equipment and comprises the steps of: (a) monitoring/controlling the communication status of the IP communication network, based on a processing status of voice data in the VoIP gateway equipment; and (b) notifying the subscriber terminal of the communication status monitored/controlled in the step (a).

According to a further aspect of the present invention, the communication-status notification method for notifying at least one subscriber terminal of a communication status in an IP (internet protocol) communication network of a VoIP (voice over internet protocol) communication system in which the subscriber

terminal is connected to the IP communication network via
VoIP gateway equipment, serving to create/analyze an IP
packet as a voice data transmission medium, so that the
subscriber terminal sends/receives voice data over the IP
communication network, comprises the steps of: at the
subscriber terminal, (a) sending to the VoIP gateway
equipment a request on monitoring/controlling or
notifying a communication status of the IP communication
network, the request being contained in voice data
transmitted over the IP communication network; at the
VoIP gateway equipment, (b) discriminating whether or not
voice data received from the subscriber terminal contains
the request sent by the subscriber terminal in the step
(a), and analyzing the content of the request contained
in the voice data received from the subscriber terminal;
(c) in response to the content of the request analyzed in
step (b), monitoring/controlling the communication status
of the IP communication network, based on a processing
status of the voice data in the VoIP gateway equipment;
and (d) in response to the content of the request
analyzed in step (b), notifying the subscriber terminal
of the communication status monitored/controlled in step
(c).

According to a further aspect of the present
invention, the recording medium, in which a
communication-status notification program is recorded,
for use in a VoIP (voice over internet protocol) gateway

-15-

equipment of an IP (internet protocol) communication system in which at least one subscriber terminal is connected to the IP communication network via the VoIP gateway equipment, serving to create/analyze an IP packet

5 as a voice data transmission medium, so that the subscriber terminal sends/receives voice data over the IP communication network, instructs the VoIP gateway equipment to function as the following: means for monitoring/controlling a communication status in the IP

10 communication network, based on a processing status of voice data in the VoIP gateway equipment; and means for notifying the subscriber terminal of the communication status of the IP communication network, which is monitored/controlled by the monitoring/controlling means,

15 via the VoIP gateway equipment.

According to a further aspect of the present invention, the recording medium, in which a communication status notification program is recorded, for use in a VoIP (voice over internet protocol) gateway equipment of

20 an IP (internet protocol) communication system in which at least one subscriber terminal is connected to the IP communication network via the VoIP gateway equipment, serving to create/analyze an IP packet as a voice data transmission medium, so that the subscriber terminal

25 sends/receives voice data over the IP communication network, instructs the VoIP gateway equipment to function as the following: means for discriminating whether or not

voice data received by the VoIP gateway equipment from the subscriber terminal contains a request on monitoring/controlling or notifying a communication status in the IP communication network, and for analyzing the content of the request contained in the voice data received from the subscriber terminal; means, responsive to the content of the request analyzed by the discriminating and analyzing means, for monitoring/controlling the communication status of the IP communication network, based on the processing status of the voice data in the VoIP gateway equipment; and means, responsive to the content of the request analyzed by the discriminating and analyzing means, for notifying the subscriber terminal of the communication status, which is monitored/controlled by the monitoring/controlling means, via the VoIP gateway equipment.

According to a further aspect of the present invention, a communication apparatus for use in a VoIP (voice over internet protocol) communication system including an IP communication network and at least one subscriber terminal, is disposed between the IP communication network and the subscriber terminal and comprises: a VoIP gateway section serving to create/analyze an IP (internet protocol) packet as a voice data transmission medium so that the subscriber terminal sends/receives voice data over the IP communication network; and a communication-status

notification section for notifying the subscriber terminal of a communication status in the IP communication network, based on a processing status of IP packet in said VoIP gateway section.

5   According to a further aspect of the present invention, a communication-status notification apparatus for a VoIP (voice over internet protocol) communication system in which at least one subscriber terminal is connected to an IP communication network via a VoIP

10   router, serving to create/analyze an IP (internet protocol) packet as a voice data transmission medium, so that the subscriber terminal sends/receives voice data over the IP communication network, is adapted to be incorporated in the VoIP router and is equipped with a

15   communication-status notification section for notifying the subscriber terminal of a communication status in the IP communication network via the VoIP router, based on a processing status of the voice data in the VoIP router.

        Accordingly, with the communication-status

20   notification apparatus, the communication-status notification method, the medium in which the communication status notification program is recorded and a communication apparatus of the present invention, since the VoIP gateway equipment notifies the subscriber

25   terminal connected to the VoIP gateway equipment of the communication status of the IP network monitored/controlled in the VoIP gateway equipment, a

subscriber to the VoIP communication system can observe various kinds of communication status of voice data in the IP network easily via the subscriber's own terminal.

Further, when the subscriber terminal sends a request regarding monitor/control of communication status or regarding notification of communication status to the VoIP gateway equipment as a form of voice data, the VoIP gateway equipment analyzes the content of the request and carries out the monitor/control of communication status or the notification of communication status to the subscriber terminal according to the analyzed content of the request, so that a subscriber can control the details of the monitor/control of communication status and the content of the notification of communication status easily via the subscriber's own terminal.

Likewise, with the communication-status display apparatus, since the communication status of the IP network notified by the VoIP gateway equipment is displayed in the subscriber terminal using materials stored in the subscriber terminal (e.g., voice, character and image), a subscriber can easily and clearly perceive various kinds of communication status of the IP network.

Obviously, the present invention is not limitedly applicable to the VoIP system, but is generically applicable to various other kinds of communication system.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a VoIP communication system to which the present invention is applied;

FIG. 2 is a block diagram showing a communication-status notification apparatus according to an aspect of the invention;

FIG. 3 is a block diagram showing a communication-status notification apparatus according to another aspect of the invention;

FIG. 4 is a block diagram showing a communication-status display apparatus according to a further aspect of the invention;

FIG. 5 is a block diagram showing VoIP gateway equipment incorporated with a communication-status notification apparatus according to a first embodiment of the present invention;

FIG. 6 is a block diagram showing a traffic-status monitor section of the communication-status notification apparatus according to the first embodiment of the present invention;

FIG. 7 is a block diagram showing a cryptographic-processing-status monitor section of the communication-status notification apparatus according to the first embodiment of the present invention;

FIG. 8 is a block diagram showing the VoIP gateway equipment incorporated with a communication-status notification apparatus according to the first embodiment

of the present invention from another angle;

FIG. 9 is a block diagram showing a subscriber terminal connected to the VoIP gateway equipment;

FIG. 10 is a block diagram showing a router included in an IP network of the VoIP communication system;

FIG. 11 illustrates a monitoring operation of a traffic status by the VoIP gateway equipment according to the first embodiment of the present invention;

FIG. 12 illustrates a notifying operation of a communication status by the VoIP gateway equipment according to the first embodiment of the present invention;

FIG. 13 illustrates a requesting operation by the subscriber terminal and a notifying operation of a communication status by the VoIP gateway equipment according to the first embodiment of the present invention;

FIG. 14 illustrates a monitoring operation of a cryptographic-processing status by the VoIP gateway equipment according to the first embodiment of the present invention;

FIG. 15 is a block diagram showing a VoIP gateway terminal incorporated with a communication-status notification apparatus according to a first modification of the first embodiment of the present invention;

FIG. 16 illustrates a monitoring operation of a

- 21 -

communication status by the VoIP gateway terminal
according to the first modification of the first
embodiment of the present invention;

FIG. 17 is a block diagram showing VoIP gateway
equipment incorporated with a communication-status
notification apparatus according to a second modification
of the first embodiment of the present invention;

FIG. 18 is a block diagram showing VoIP gateway
equipment incorporated with a communication-status
notification apparatus according to a third modification
of the first embodiment of the present invention;

FIG. 19 illustrates a cryptographic-processing
operation by the VoIP gateway equipment incorporated with
the communication-status notification apparatus according
to the third modification of the first embodiment of the
present invention;

FIG. 20 is a block diagram showing VoIP gateway
equipment incorporated with a communication-status
notification apparatus according to a fourth modification
of the first embodiment of the present invention;

FIG. 21 is a block diagram showing a subscriber
terminal incorporated with a communication-status display
apparatus according to a fifth embodiment of the first
embodiment of the present invention; and

FIG. 22 illustrates a conventional VoIP
communication system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(A) Description of Aspects of the Invention:

First of all, several fundamental aspects of the present invention will now be described with reference to FIGs. 1-4.

In the following description, a VoIP system (a VoIP communication system) is supposed as an example of such communication system. Also, an IP network (an IP communication network) is supposed as an example of such network (communication network) accordingly.

FIG. 1 illustrates a VoIP communication system to which a communication-status notification apparatus or a communication-status display apparatus according to the present invention is applied. In the VoIP communication system, an IP network (IP communication network) 9 is connected with plural sets of VoIP gateway equipment 1A (for example, a gateway or a router) and with VoIP gateway terminals 1T, and at least one subscriber terminal 2A is connected to each of the VoIP gateway equipment 1A, so that each subscriber terminal 2A or each VoIP gateway terminal 1T sends/receives voice data over the IP network 9.

Each of the VoIP gateway terminals 1T has a VoIP-gateway mechanism 1T-1 and a subscriber-terminal mechanism 1T-2. In the following description, each set

- 23 -

of the VoIP gateway equipment 1A and the VoIP-gateway

mechanism 1T-1 of each of the VoIP gateway terminals 1T

are generically referred to as VoIP gateway equipment 1

when not specified as either of the VoIP gateway

5   equipment 1A or the VoIP-gateway mechanism 1T-1.

Likewise, each of the subscriber terminals 2A and the

subscriber-terminal mechanism 1T-2 of each of the VoIP

gateway terminals 1T are generically referred to as a

subscriber terminal 2.

10   A communication-status notification apparatus

according to the present invention is adapted to be

incorporated in the VoIP gateway equipment 1 (for example,

a gateway or a router) in the VoIP communication system

as shown in FIG. 1. The VoIP gateway equipment 1 serves

15   a voice-data sending/receiving function by

creating/analyzing an IP packet as a voice data

transmission medium.

According to one aspect of the present invention,

as shown in FIG. 2, a communication-status notification

20   apparatus is equipped with a communication-status-

notification management section 3&4 for notifying the

subscriber terminal 2 connected to the VoIP gateway

equipment 1 of a communication status in the IP network 9

via the VoIP gateway equipment 1, based on a processing

25   status of the voice data in the VoIP gateway equipment 1.

With this arrangement, the VoIP gateway equipment 1

notifies the subscriber terminal 2 connected to the VoIP

gateway equipment 1 of the communication status of the IP

network 9 monitored/controlled in the VoIP gateway

equipment 1, so that a subscriber to the VoIP

communication system can observe various kinds of

5   communication status of voice data in the IP network

easily via the subscriber's own terminal 2.

Preferably, the communication-status-notification

management section 3&4 combines the function of a

communication-status monitor/control section 3 and the

10   function of a communication-status notification section 4.

The communication-status monitor/control section 3

has a function of monitoring/controlling the

communication status of the IP network 9, based on the

processing status of the voice data in the VoIP gateway

15   equipment 1. The communication-status notification

section 4 has a function of notifying the subscriber

terminal 2 of the communication status

monitored/controlled by the communication-status

monitor/control section 3 via the VoIP gateway equipment

20   1.

According to another aspect of the present

invention as shown in FIG. 3, a communication-status

notification apparatus has a request analysis section 5,

in addition to the communication-status monitor/control

25   section 3 and the communication-status notification

section 4 as described above.

The request analysis section 5 discriminates

whether or not voice data received by the VoIP gateway
equipment 1 from the subscriber terminal 2 connected to
the VoIP gateway equipment 1 contains a request on
monitoring/controlling or notifying of a communication
status in the IP network 9, and analyzes the content of
the request contained in the voice data received from the
subscriber terminal 2.

Each of the communication-status monitor/control
section 3 and the communication-status notification
section 4 carries out the functions as described above,
in response to the content of the request analyzed by the
request analysis section 5.

With this arrangement, when the subscriber terminal
2 sends a request regarding monitor/control of
communication status or notification of communication
status to the VoIP gateway equipment 1 as a form of voice
data, the VoIP gateway equipment 1 analyzes the content
of the request and carries out the monitor/control of
communication status or the notification of communication
status to the subscriber terminal 2 according to the
analyzed content of the request, so that a subscriber can
control the details of the monitor/control of various
kinds of communication status or the content of the
notification of communication status easily via the
subscriber's own terminal 2.

Preferably, the communication-status
monitor/control section 3 starts or stops the

monitor/control of the communication status according to the content of the request analyzed by the request analysis section 5 when the content of the request is related with starting or stopping of the monitor/control of the communication status.

With this arrangement, a subscriber can easily start/stop the monitor/control of various kinds of communication status of the IP network 9, simply by use of the subscriber's own terminal 2.

Also preferably, the communication-status notification section 4 starts or stops, when the content of the request analyzed by the request analysis section 5 is related with starting or stopping of the notification of the communication status, the notification of the communication status according to the content of the request, and notifies, when the content of the request analyzed by the request analysis section 5 is related with selecting of a kind of the communication status to be notified, of the selected kind of the communication status according to the content of the request.

With this arrangement, a subscriber can easily start/stop the notification of various kinds of communication status of the IP network 9, or easily select a kind of communication status of the IP network 9 of which kind the subscriber want to be notified, simply by use of the subscriber's own terminal 2.

As another preferable feature, the communication-

- 27 -

status notification section 4 includes a notification-material storage section for storing at least one of voice, character and image as notification materials, and notifies of communication status using the notification materials stored in the notification-material storage section.

With this arrangement, since the communication status of the IP network 9 is sent to and displayed on the subscriber terminal 2, a subscriber can easily and clearly perceive various kinds of communication status of the IP network 9.

As still another preferable feature, the communication-status monitor/control section 3 includes a traffic-status monitor/control section for monitoring/controlling a traffic status in the IP network 9 as one aspect of monitor/control of the communication status, based on a sending/receiving status of IP packets in the VoIP gateway equipment 1.

With this arrangement, a subscriber can easily perceive the traffic status of the IP network 9, and also can easily control the details of the monitor/control or the notification of the traffic status of the IP network 9, simply by use of the subscriber's own terminal 2.

Preferably, the traffic-status monitor/control section includes: a traffic-information request section for requesting each of one or more routers, which are included in the IP network 9, to send to the VoIP gateway

starting the selected cryptographic process, the request-receiving control section 52 controls the cryptographic-processing-status monitor section 35 to discriminate whether or not a VoIP gateway equipment, connected with a companion subscriber terminal for voice call, is able to carry out the cryptographic process selected by the request from the subscriber terminal.

During the discriminating, the communication-status-notification control section 42 controls the interface section 11 to notify the subscriber terminal 2 of a message requesting the subscriber to wait for a while.

When the companion VoIP gateway equipment turned out to be capable of carrying out the cryptographic process specified by the subscriber as a result of the discrimination by the cryptographic-processing-status monitor section 35, the cryptographic-processing selection/control section 36 controls the cryptographic-processing section 34 to start the selected cryptographic process. Further, the communication-status-notification control section 42 controls the interface section 11 to notify the subscriber terminal 2 of a message that the selected cryptographic process has just been started.

On the contrast, when the companion VoIP gateway equipment turned out not to be capable of carrying out the cryptographic process selected by the subscriber as a result of the discrimination by the cryptographic-

equipment 1 information about the traffic status in each
of the routers, by transmitting a request signal to each
of the routers via the VoIP gateway equipment 1; a
traffic-information obtaining section for obtaining the
information about the traffic status, which has been sent
from each of the routers in response to the request
signal transmitted by the traffic-information request
section, out of various data received by the VoIP gateway
equipment 1; and a traffic-status analysis section for
analyzing the traffic status of the IP communication
network based on the traffic-status information obtained
by the traffic-information obtaining section.

With this arrangement, it is possible to monitor
the traffic status of the IP network 9 with a simple
structure, utilizing effectively a monitoring function of
a received IP packet, which function is equipped with the
conventional VoIP gateway equipment.

Also preferably, the traffic-status monitor/control
section includes: a test-packet sending section for
sending one or more test IP packets to other VoIP gateway
equipment 1, which is connected to the IP network 9 and
serves as a companion with the VoIP gateway equipment 1
for voice data transmission, via the VoIP gateway
equipment 1; a test-packet retrieving section for
retrieving the individual test IP packets, which have
been sent back from the companion VoIP gateway equipment
1, via the VoIP gateway equipment 1; and a traffic-status

- 29 -

analysis section for analyzing the traffic status of the
IP network 9, based on the retrieving status of the test
IP packets by the test-packet retrieving section.

With this arrangement, it is possible to monitor
the traffic status of the IP network 9 with a simple
structure, utilizing effectively a function for
monitoring a received IP packet, which function is
equipped with the conventional VoIP gateway equipment.

It is also preferable that the traffic-status
monitor/control section includes a communication-quality
evaluation section for evaluating communication quality
of voice data transmitted over the IP network 9, based on
the traffic status monitored by the traffic-status
monitor/control section, and that the communication-
status notification section 4 notifies the subscriber
terminal 2 of information about the communication quality
of voice data evaluated by the communication-quality
evaluation section.

With this arrangement, a subscriber can easily
perceive the communication quality of voice data in the
IP network 9, simply by use of the subscriber's own
terminal 2.

More preferably, the traffic-status monitor/control
section includes a bandwidth-alteration request section,
responsive to the communication quality of voice data
evaluated by the communication-quality evaluation section,
for requesting each of one or more routers, which are

included in the IP network 9, to alter a bandwidth to be used for voice data transmission, by transmitting a request signal to each of the routers via the VoIP gateway equipment 1.

5   With this arrangement, a subscriber can easily take measures to improve the communication quality of voice data, simply by use of the subscriber's own terminal 2.

As still another preferable feature, the communication-status monitor/control section 3 includes a

10   cryptographic-processing-status monitor/control section for monitoring/controlling a cryptographic-processing status of voice data transmitted over the IP network 9 as one aspect of monitor/control of the communication status.

With this arrangement, a subscriber can easily

15   perceive the cryptographic-processing status of voice data transmitted over the IP network 9, and also can easily control the details of the monitor/control or notification of the cryptographic-processing status of voice data, simply by use of the subscriber's own

20   terminal 2.

It is preferable that the cryptographic-processing-status monitor/control section includes a cryptographic-processing section for cryptographic-processing voice data sent/received by the VoIP gateway equipment 1, and

25   that the communication-status notification section 4 is operable to notify the subscriber terminal 2 of the cryptographic-processing status of voice data by the

cryptographic-processing section.

With this arrangement, a subscriber can easily set/reset the cryptographic processing of voice data by the cryptographic-processing section, and also can perceive the cryptographic-processing status of voice data by the cryptographic-processing section, simply by use of the subscriber's own terminal 2.

More preferably, the cryptographic-processing section carries out at least one of scramble, encryption and interleave as the cryptographic process.

With this arrangement, a subscriber can easily select an optimum cryptographic process to be carried out on voice data from several cryptographic processes, which are commonly used in a conventional data communication, simply by use of the subscriber's own terminal 2.

It is also preferable that the cryptographic-processing-status monitor/control section further includes a cryptographic-processing-status monitor section for monitoring a cryptographic-processing status of voice data by other VoIP gateway equipment 1, which is connected to the IP network 9 and serves as a companion with the VoIP gateway equipment 1 for voice data transmission, based on a transmission status of IP packets between the VoIP gateway equipment 1 and the companion VoIP gateway equipment 1, and that the cryptographic-processing section carries out the cryptographic-processing in accordance with the

cryptographic-processing status of the companion VoIP
gateway equipment 1 monitored by the cryptographic-
processing-status monitor section.

With this arrangement, a subscriber can perceive
cryptographic-processing status carried out in the
companion VoIP gateway equipment 1, and also can set the
cryptographic processing of voice data in the VoIP
gateway equipment 1, simply by use of the subscriber's
own terminal 2.

In addition to the communication-status
notification apparatus as described above, there is also
provided a communication apparatus (such as a VoIP
gateway terminal 1T in FIG. 1) according to an aspect of
the present invention, which includes the communication-
status notification mechanism substantially equivalent to
the above-described communication-status notification
apparatus.

In the meantime, a communication-status display
apparatus according to the present invention is
incorporated in the subscriber terminal 2 used in the
VoIP communication system as shown in FIG. 1.

According to an aspect of the present invention, as
shown in FIG. 4, the communication-status display
apparatus is equipped with a notified-information
detection section 6, a display-material storage section 7
and a communication-status display section 8.

The notified-information detection section 6

detects information about the communication status of the IP network 9, which status is monitored/controlled by the VoIP gateway equipment 1 connected to the subscriber terminal 2, when the subscriber terminal 2 is notified of the communication-status information from the VoIP gateway equipment 1.

The display-material storage section 7 stores at least one of voice, character and image as display materials.

The communication-status display section 8 displays the communication status of the IP network 9, based on the communication-status information detected by the notified-information detection section 6, using the display materials stored in the display-material storage section.

With this arrangement, the communication status notified of by the VoIP gateway equipment is displayed on the subscriber terminal, a subscriber can easily and clearly perceive various kinds of communication status of the IP network.

In the meantime, a communication-status notification method according to the present invention is used for notifying at least one subscriber terminal 2 of a communication status in an IP network 9 of a VoIP communication system as shown in FIG. 1, in which system the subscriber terminal 2 is connected to the IP network 9 via VoIP gateway equipment 1, serving to create/analyze

- 34 -

an IP packet as a voice data transmission medium, so that the subscriber terminal 2 sends/receives voice data over the IP network 9.

According to one aspect of the present invention, the communication-status notification method is carried out at the VoIP gateway equipment 1 connected with the subscriber terminal 2 and includes the steps of:

(a) monitoring/controlling the communication status of the IP network 9, based on a processing status of voice data in the VoIP gateway equipment 1; and

(b) notifying the subscriber terminal 2 of the communication status monitored/controlled in the step (a).

With this feature, the VoIP gateway equipment 1 notifies the subscriber terminal 2 connected to the VoIP gateway equipment 1 of the communication status of the IP network 9 monitored/controlled in the VoIP gateway equipment 1, so that a subscriber to the VoIP communication system can observe various kinds of communication status of voice data in the IP network easily via the subscriber's own terminal 2.

According to another aspect of the present invention, the communication-status notification method includes the steps of:

at the subscriber terminal 2,

(a) sending to the VoIP gateway equipment 1 connected with the subscriber terminal 2 a request on monitoring/controlling or notifying of a communication

-35-

status of the IP network 9, wherein the request is
contained in voice data transmitted over the IP network
9;

at the VoIP gateway equipment 1,

5   (b) discriminating whether or not voice data
received from the subscriber terminal 2 contains the
request sent by the subscriber terminal 2 in the step (a),
and analyzing the content of the request contained in the
voice data received from the subscriber terminal 2;

10   (c) in response to the content of the request
analyzed in the step (b), monitoring/controlling the
communication status of the IP network 9, based on a
processing status of the voice data in the VoIP gateway
equipment 1; and

15   (d) in response to the content of the request
analyzed in the step (b), notifying the subscriber
terminal 2 of the communication status
monitored/controlled in the step (c).

With this feature, when the subscriber terminal 2
20 sends a request regarding monitor/control of
communication status or notification of communication
status to the VoIP gateway equipment 1 as a form of voice
data, the VoIP gateway equipment 1 analyzes the content
of the request and carry out the monitor/control of
25 communication status or the notification of communication
status to the subscriber terminal 2 according to the
analyzed content of the request, so that a subscriber can

control the details of the monitor/control or notification of various kinds of communication status easily via the subscriber's own terminal 2.

In the meantime, a recording medium according to the present invention, in which a communication-status notification program is recorded, is used in a VoIP gateway equipment 1 of a VoIP communication system shown in FIG. 1, in which at least one subscriber terminal 2 is connected to an IP network 9 via the VoIP gateway equipment 1, serving to create/analyze an IP packet as a voice data transmission medium, so that the subscriber terminal 2 sends/receives voice data over the IP network 9.

According to one aspect of the present invention, the communication-status notification program recorded in the subject medium instructs the VoIP gateway equipment 1 to function as:

means for monitoring/controlling a communication status in the IP network 9, based on a processing status of voice data in the VoIP gateway equipment 1; and

means for notifying the subscriber terminal 2 connected to the VoIP gateway equipment 1 of the communication status of the IP network 9, which is monitored/controlled by the monitoring/controlling means, via the VoIP gateway equipment 1.

With this feature, the VoIP gateway equipment 1 notifies the subscriber terminal 2 connected to the VoIP

gateway equipment 1 of the communication status of the IP

network 9 monitored/controlled in the VoIP gateway

equipment 1, so that a subscriber to the VoIP

communication system can observe various kinds of

5   communication status of voice data in the IP network 9

easily via the subscriber's own terminal 2.

According to another aspect of the present

invention, the communication-status notification program

recorded in the subject medium instructs the VoIP gateway

10   equipment 1 to function as:

means for discriminating whether or not voice data

received by the VoIP gateway equipment 1 from the

subscriber terminal 2 connected with the VoIP gateway

equipment 1 contains a request on monitoring/controlling

15   or notifying of a communication status in the IP network

9, and for analyzing the content of the request contained

in the voice data received from the subscriber terminal

2;

means, responsive to the content of the request

20   analyzed by the discriminating and analyzing means, for

monitoring/controlling the communication status of the IP

network 9, based on the processing status of the voice

data in the VoIP gateway equipment 1; and

means, responsive to the content of the request

25   analyzed by the discriminating and analyzing means, for

notifying the subscriber terminal 2 of the communication

status, which is monitored/controlled by the

-38-

monitoring/controlling means, via the VoIP gateway

equipment 1.

      With this feature, when the subscriber terminal 2

sends a request regarding monitor/control of

5   communication status or notification of communication

status to the VoIP gateway equipment 1 as a form of voice

data, the VoIP gateway equipment 1 analyzes the content

of the request and carry out the monitor/control or

notification of the communication status to the

10   subscriber terminal 2 according to the analyzed content

of the request, so that a subscriber can control the

details of the monitor/control of communication status or

the notification of communication status easily via the

subscriber's own terminal 2.

15

(B) Description of the Preferred Embodiments:

      In the following, preferred embodiments of the

present invention will be described with reference to the

drawings.

20   (1) Description of First Embodiment of the Present

Invention:

      FIG. 1 shows a VoIP communication system including

VoIP gateway equipment 1A, in which a communication-

status notification apparatus according to the present

25   invention is incorporated.

      Already referred to in the description of the

aspects of the present invention, the VoIP communication

system shown in FIG. 1 is again referred to for
describing a first embodiment of the present invention,
because the VoIP communication system is similar to that
of the first embodiment in that: an IP network 9 is
5   connected with plural sets of VoIP gateway equipment 1A
and with VoIP gateway terminals 1T, and at least one
subscriber terminal 2A is connected to each of the VoIP
gateway equipment 1A, so that each subscriber terminal 2A
or each VoIP gateway terminal 1T sends/receives voice
10   data over the IP network 9.

        Not shown in FIG. 1, one or more routers are
provided in the IP network 9, for transmitting IP packets
containing voice data, which is sent/received by plural
subscriber terminals 2 each connected to the IP network 9
15   via VoIP gateway equipment 1, and also for controlling
routing of the IP packets in association with the
transmission of the IP packets, so that the plural
subscriber terminals 2 can interchange the IP packets.

        In the meantime, a communication status in an IP
20   network, which is to be monitored/controlled or notified
by the communication-status notification apparatus
according to the present invention, means various kinds
of information regarding communication quality of voice
data over the IP network. The communication-status
25   notification apparatus according to the embodiment has an
arrangement so as to cope with two kinds of communication
status as actual examples of such communication status of

the IP network: a status of traffic of voice data
(traffic status of voice data) in the IP network; and a
status of cryptographic-processing carried out on voice
data (cryptographic-processing status of voice data).

5   (1-1) Description of Arrangements According to the
First Embodiment of the Present Invention:

(i) Description of Arrangement of VoIP Gateway
Equipment Provided with Communication-Status Notification
Apparatus According to the First Embodiment of the

10   Present Invention

FIGs. 5-8 are block diagrams each showing VoIP
gateway equipment incorporated with the communication-
status notification apparatus according to the first
embodiment of the present invention.

15   In FIG. 5, the VoIP gateway equipment is equivalent
to, for example, the VoIP gateway equipment 1A shown in
FIG. 1, being equipped with the VoIP-gateway mechanism
for transmitting voice data by converting a voice signal
into IP packets, and vice versa, and also with a

20   mechanism for notifying the communication status
according to the present invention (the communication-
status notification apparatus).

The VoIP gateway equipment 1A shown in FIG. 5
includes several components to serve as the VoIP-gateway

25   mechanism: an interface section 11, an audio CODEC
section 12, an IP-packet creation/analysis section 13 and
a dial-tone-multi-frequency-signal (DTMF-signal)

detection section 14.

The interface section 11 is connected to an external device, such as a PBX trunk, and carries out an interface process on a voice signal in relation with input/output of the voice signal between the VoIP gateway equipment 1A and the external device. The audio CODEC section 12 carries out compression/decompression process (CODEC process) of voice data associated with the voice signal interface-processed in the interface section 11 or IP-packetized/IP-depacketized in the IP-packet creation/analysis section 13. The IP-packet creation/analysis section 13 carries out IP-packetization/IP-depacketization (creation/analysis of IP packets) of the voice signal compression/decompression-processed by the audio CODEC section 12, and is connected to the IP network 9 so as to send/receive IP packets to/from the IP network 9.

The DTMF-signal detection section 14 detects dial-tone-multi-frequency signal (DTMF signal) out of signals that are interface-processed in the interface section 11.

With this arrangement, when inputted to the interface section 11, the voice signal is compression-processed by the audio CODEC section 12, then IP-packetized by the IP-packet creation/analysis section 13 to be converted into IP packets, and finally sent out to the IP network. Also, when received from the IP network, IP packets are depacketized by the IP-packet

creation/analysis section 13 to be converted into a voice
signal, then decompression-processed by the audio CODEC
section 12, and finally outputted from the interface
section 11.

5   In the meantime, the function of each of the
components associated with the VoIP-gateway mechanism
varies slightly according to a kind of the VoIP gateway
equipment 1A.

          If the VoIP gateway equipment 1A is a VoIP gateway
10   apparatus, for example, the interface section 11 is
connected to a PSTN or an ISDN, or a subscriber terminal
such as a telephone, and carries out input/output-
interface process on an analog voice signal or a digital
voice signal.

15   If the VoIP gateway equipment 1A is a VoIP trunk,
the interface section 11 is connected to an exchange such
as a PBX and carries out input/output-interface process
on a voice signal (such as an analog voice signal, a
digital voice signal or a signal which is used in a
20   common signaling system on the D channel and transmitted
between two exchanges), and the IP-packet
creation/analysis section 13 carries out IP-
packetization/IP-depacketization of the voice signal
received from the exchange and interface-processed by the
25   interface section 11.

          A voice signal actually undergoes various processes
other than the above-mentioned processes in relation with

the VoIP-gateway mechanism, such as a voice-addition/level-control process or, if the voice signal from the subscriber terminal is an analog voice signal, an encoding/decoding process, which processes are omitted as functional blocks in FIG. 5.

In addition to the above-mentioned components associated with the VoIP-gateway mechanism, the VoIP gateway equipment 1A in FIG. 5 further has components to function as the communication-status notification apparatus according to the present invention: a communication-status monitor/control section 30, a communication-status notification section 40 and a request analysis section 50.

The communication-status monitor/control section 30 monitors/controls a communication status in the IP network 9, based on the processing status of voice data in the VoIP gateway equipment 1A. The communication-status notification section 40 notifies the subscriber terminal 2A of the communication status monitored/controlled by the communication-status monitor/control section 30 via the VoIP gateway equipment 1A.

The request analysis section 50 discriminates whether or not voice data received by the VoIP gateway equipment 1A from the connected subscriber terminal 2A contains a request on monitoring/controlling or notifying of the communication status of the IP network 9, and

analyzes the content of the request contained in the voice data received from the subscriber terminal 2A. The communication-status monitor/control section 30 and the communication-status notification section 40 carry out

5 the monitoring/controlling or notifying in response to the content of the request analyzed by the analysis section 50.

The communication-status monitor/control section 30 includes a traffic-status monitor section 31, a

10 communication-quality evaluation section 32, a bandwidth-alteration request section 33, a cryptographic-processing section 34, a cryptographic-processing-status monitor section 35, a cryptographic-processing selection/control section 36 and a communication-status storage section 37.

15 The traffic-status monitor section 31 monitors a traffic status in the IP network 9 by controlling the IP-packet creation/analysis section 13 and includes a router-information request section 311, a router-information obtaining section 312, a router-information

20 analysis section 313, a test-packet-sending control section 314, a test-packet-retrieval control section 315, a test-packet-retrieval analysis section 316 and a test-packet-sending-back control section 317, as shown in FIG. 6.

25 The router-information request section 311 controls the IP-packet creation/analysis section 13 to create an information-request IP packet (a request signal), which

- 45 -

requests each of one or more routers included in the IP
network 9 to send information about the traffic status in
each router to the VoIP gateway equipment A1, and to
transmit the information-request IP packet to the routers
via the IP-packet creation/analysis section 13, thereby
requesting each of the routers to send the traffic-status
information.

The router-information obtaining section 312
controls the IP-packet creation/analysis section 13 to
detect IP packets containing the traffic-status
information, which packets were sent from the routers in
the IP network 9 in response to the information-request
IP packet, out of IP packets received at the IP-packet
creation/analysis section 13 from the IP network 9, and
obtains the traffic-status information by controlling the
depacketizing of the detected IP packets by the IP-packet
creation/analysis section 13.

The router-information analysis section 313
analyzes the traffic status of the IP network 9, based on
the traffic-status information sent from the routers and
obtained by the router-information obtaining section 312.

That is to say, the router-information request
section 311, the router-information obtaining section 312
and the router-information analysis section 313, as
described above, are included in the traffic-status
monitor section 31 (which is a component of a traffic-
status monitor/control section as described later), and

each functions as, respectively: a traffic-information request section for requesting each of one or more routers included in the IP network 9 to send information about the traffic status in each of the routers to the VoIP gateway equipment 1A, by transmitting a request signal to each of the routers via the VoIP gateway equipment 1A; a traffic-information obtaining section for obtaining the information about the traffic status, which was sent from each of the routers in response to the request signal transmitted by the traffic-information request section, out of various data received by the VoIP gateway equipment 1A; and a traffic-status analysis section for analyzing the traffic status of the IP network 9, based on the traffic-status information obtained by the traffic-information obtaining section.

The test-packet-sending control section 314 of the VoIP gateway equipment 1A controls the IP-packet creation/analysis section 13 to create one or more test IP packets, which contain a signal to request other VoIP gateway equipment 1 to send the packets back to the former VoIP gateway equipment 1A when the later VoIP gateway equipment 1 receives the packets, and to send the created test IP packets over the IP network to the later VoIP gateway equipment 1, which is connected to the IP network 9 and serves as a companion to the VoIP gateway equipment 1A for voice data transmission.

The test-packet-retrieval control section 315

controls the IP-packet creation/analysis section 13 to
detect the individual test IP packets, which were first
sent out from the former VoIP gateway equipment 1A and
then sent back from the later VoIP gateway equipment 1

5   (companion VoIP gateway equipment), out of IP-packets
received from the IP network 9 by the IP-packet
creation/analysis section 13 .so as to retrieve the test
IP packets, and to monitor a retrieving state of the test
IP packets in the IP-packet creation/analysis section 13.

10   The test-packet-retrieval analysis section 316
analyzes the traffic status of the IP network 9, based on
the retrieving status of the test IP packets monitored by
the test-packet-retrieval control section 315.

        That is to say, the test-packet-sending control

15   section 314, the test-packet-retrieval control section
315 and the test-packet-retrieval analysis section 316 as
described above are included in the traffic-status
monitor section 31 (which is a component of a traffic-
status monitor/control section as described later) of the

20   VoIP gateway equipment 1A, and each functions as,
respectively: a test-packet sending section for sending
one or more test IP packets via the VoIP gateway
equipment 1A to other VoIP gateway equipment 1, which is
connected to the IP network 9 and serves as a companion

25   to the former VoIP gateway equipment 1A for voice data
transmission; a test-packet retrieving section for
retrieving the individual test IP packet, which has been

sent back from the later (companion) VoIP gateway

equipment 1, out of IP packets received by the former

VoIP gateway equipment 1A; and a traffic-status analysis

section for analyzing the traffic status of the IP

5   network 9, based on the retrieving status of the test IP

packets by the test-packet retrieving section.

The test-packet-sending-back control section 317 of

the VoIP gateway equipment 1A controls the IP-packet

creation/analysis section 13 to detect a test IP packet,

10   which was sent from other VoIP gateway equipment 1A

connected to the IP network 9, out of IP packets received

from the IP network 9 by the IP-packet creation/analysis

section 13 and to send the detected test IP packet back

to the later VoIP gateway equipment 1A, from which the

15   test IP packet was sent, in response to a request signal

contained in the test IP packet.

With the arrangement as described above, the

traffic-status monitor section 31 has a function to

monitor a traffic status in the IP network 9.

20   The communication-quality evaluation section 32

shown in FIG. 5 (which is a component of a traffic-status

monitor/control section as described later) evaluates

communication quality of voice data transmitted over the

IP network 9, based on the traffic status monitored by

25   the traffic-status monitor section 31.

The bandwidth-alteration request section 33 (which

is a component of a traffic-status monitor/control

section as described later) requests each of one or more routers included in the IP network 9 to alter a bandwidth to be used for voice data transmission in response to the communication quality of voice data evaluated in the communication-quality evaluation section 32, by transmitting a request signal to each of the routers via the VoIP gateway equipment 1A.

Specifically, the bandwidth-alteration request section 33 controls the IP-packet creation/analysis section 13, based on the evaluation of communication quality of voice data in the IP network 9 by the communication-quality evaluation section 32, to create a bandwidth-alteration request IP packet, which contains a signal requesting a router to alter a bandwidth to be used for voice data transmission, and to send the created bandwidth-alteration request IP packet over the IP network 9 to each of the routers in the IP network 9.

The cryptographic-processing section 34 (which is a component of a cryptographic-processing-status monitor/control section as described later) carries out a cryptographic process on voice data sent/received via the IP-packet creation/analysis section 13 of the VoIP gateway equipment 1A and, further, is able to select one of a scramble process, an encryption process and an interleave process as the cryptographic process.

The cryptographic-processing-status monitor section 35 (which is a component of a cryptographic-processing-

status monitor/control section as described later)
controls the IP-packet creation/analysis section 13 to
monitor a status of cryptographic processing for data
transmission by other VoIP gateway equipment 1A connected
to the IP network 9. As shown in FIG. 7, the
cryptographic-processing-status monitor section 35
includes a cryptographic-processing-information request
section 351, a cryptographic-processing-information
obtaining section 352, a cryptographic-processing-
information analysis section 353 and a cryptographic-
processing-information sending section 354.

The cryptographic-processing-information request
section 351 of the VoIP gateway equipment 1A controls the
IP-packet creation/analysis section 13 to create one or
more cryptographic-processed-data IP packets, containing
data on which one of the scramble process, the encryption
process and the interleave process is carried out as the
cryptographic process, and one or more cryptographic-
processing-request IP packets, containing a signal
requesting other VoIP gateway equipment 1A, connected to
the IP network 9, to decipher the cryptographic-processed
data and to send back the deciphered data, and to send
these cryptographic-processed-data IP packets and the
cryptographic-processing-request IP packets over IP
network 9 toward the later VoIP gateway equipment 1A.

The cryptographic-processing-information obtaining
section 352 controls the IP-packet creation/analysis

-51-

section 13 to detect one or more IP packets, which
contain deciphered data of the cryptographic-processed-
data IP packets and are sent from other VoIP gateway
equipment 1A connected to the IP network 9 in response to
the cryptographic-processing-request IP packets, out of
IP packets received at the IP-packet creation/analysis
section 13 from the IP network 9, and obtains the
deciphered data by controlling the depacketizing of the
detected IP packets by the IP-packet creation/analysis
section 13.

The cryptographic-processing-information analysis
section 353 analyzes a cryptographic-processing status by
the other VoIP gateway equipment 1A, based on the
deciphered data sent from the other VoIP gateway
equipment 1A and received by the cryptographic-
processing-information obtaining section 352.

The cryptographic-processing-information sending
section 354 controls the IP-packet creation/analysis
section 13 to detect cryptographic-processed-data IP
packets and cryptographic-processing-request IP packets,
both of which are received from other VoIP gateway
equipment 1A connected to the IP network 9, out of IP
packets received from the IP network 9 by the IP-packet
creation/analysis section 13. In response to a request
signal contained in the cryptographic-processing-request
IP packets, the cryptographic-processing-information
sending section 354 deciphers cryptographic-processed

- 52 -

data contained in the cryptographic-processed-data IP packets and then controls the IP-packet creation/analysis section 13 to create IP packets containing the deciphered data of the cryptographic-processed data and to send the created IP packets to the other VoIP gateway equipment 1A, from which the cryptographic-processed-data IP packets and the cryptographic-processing-request IP packets were sent.

With the arrangement as described above, the cryptographic-processing-status monitor section 35 of the VoIP gateway equipment 1A has a function to monitor a cryptographic-processing status of voice data by other VoIP gateway equipment 1A, which is connected to the IP network 9 and serves as a companion to the former VoIP gateway equipment 1A for voice data transmission, based on a transmission status of IP packets between the former VoIP gateway equipment 1A and the later (companion) VoIP gateway equipment.

The cryptographic-processing selection/control section 36 (which is a component of a cryptographic-processing-status monitor/control section as described later) selects a kind of cryptographic process for data transmission to be carried out by the cryptographic-processing section 34, and controls the cryptographic processing by the cryptographic-processing section 34, in accordance with the cryptographic-processing status in the other VoIP gateway equipment 1A monitored by the

cryptographic-processing-status monitor section 35.

The communication-status storage section 37 stores the traffic status of the IP network 9 monitored by the traffic-status monitor section 31, the communication quality of voice data evaluated by the communication-quality evaluation section 32 and the result of selection and control of cryptographic processing by the cryptographic-processing selection/control section 36.

That is to say, the traffic-status monitor section 31, the communication-quality evaluation section 32, the bandwidth-alteration request section 33 and the communication-status storage section 37 combine to function as a traffic-status monitor/control section for monitoring/controlling a traffic status in the IP network 9 as one aspect of monitor/control of the communication status, based on a sending/receiving status of IP packets in the VoIP gateway equipment 1A.

Further, the cryptographic-processing section 34, the cryptographic-processing-status monitor section 35, the cryptographic-processing selection/control section 36 and the communication-status storage section 37 combine to function as a cryptographic-processing-status monitor/control section for monitoring/controlling a cryptographic-processing status of voice data transmitted over the IP network 9 as another aspect of monitor/control of the communication status.

Accordingly, with the arrangement as described

above, the communication-status monitor/control section

30 functions to monitor/control the communication status

of the IP network 9, based on the processing status of

the voice data in the VoIP gateway equipment 1A.

In the meantime, the communication-status

notification section 40 has a notification-material

storing section 41 and a communication-status-

notification control section 42.

The notification-material storing section 41 stores

at least one of voice, character and image as

notification materials indicating the traffic status of

the IP network 9 monitored by the traffic-status monitor

section 31, the communication quality of voice data

evaluated by the communication-quality evaluation section

32 and the result of selection and control of

cryptographic processing by the cryptographic-processing

selection/control section 36, which are stored in the

communication-status storage section 37.

The communication-status-notification control

section 42 notifies the subscriber terminal 2A via the

interface section 11 of the traffic status of the IP

network 9 monitored by the traffic-status monitor section

31, the communication quality of voice data evaluated by

the communication-quality evaluation section 32 and the

result of selection and control of cryptographic

processing by the cryptographic-processing

selection/control section 36, which are stored in the

communication-status storage section 37, using the notification materials stored in the notification-material storing section 41.

The communication-status-notification control section 42 is also operable to notify the subscriber terminal 2A of the various kinds of information stored in the communication-status storage section 37 in the form of voice signal by controlling directly the interface section 11.

The communication-status-notification control section 42 is further operable to recognize a kind of the subscriber terminal 2A connected to the interface section 11, by monitoring a voice signal that undergoes the input/output process by the interface section 11.

With the arrangement as described above, the communication-status notification section 40 has a function to notify the subscriber terminal 2A of the communication status monitored/controlled by the communication-status monitor/control section 30 via the VoIP gateway equipment 1A.

Also with the arrangement as described above, the communication-status notification section 40 is equipped with a notification-material storing section 41 for storing at least one of voice, character and image as notification material, and has a function to carry out the notification of communication status, using the notification material stored in the notification-material

storing section 41.

Further, with the arrangement as described above, the communication-status notification section 40 has a function to notify the subscriber terminal 2 of the communication quality evaluated by the communication-quality evaluation section 32.

Still further, with the arrangement as described above, the communication-status notification section 40 has a function to notify the subscriber terminal 2 of the result of control of a cryptographic-processing status by the cryptographic-processing selection/control section 36, namely, a cryptographic processing state by the cryptographic-processing section 34.

In the meantime, the request analysis section 50 has a request-information analysis section 51 and a request-receiving control section 52.

The request-information analysis section 51 discriminates whether or not there is a DTMF signal corresponding to a request on monitoring/controlling or notifying of a communication status among DTMF signals detected by the DTMF-signal detection section 14, and analyzes the content of a request if any DTMF signal corresponding to the request is included in the detected DTMF signals.

The request-receiving control section 52 controls each of the monitoring of the traffic status of the IP network 9 by the traffic-status monitor section 31, the

evaluation of the communication quality of voice data by

the communication-quality evaluation section 32, the

selecting/controlling of the cryptographic processing by

the cryptographic-processing selection/control section 36

and the notifying of the various kinds of information by

the communication-status-notification control section 42,

based on the content of the request analyzed by the

request-information analysis section 51.

With the arrangement as described above, the

request analysis section 50 has a function to

discriminate whether or not voice data received by the

VoIP gateway equipment 1A from the subscriber terminal 2A

contains a request on monitoring/controlling or notifying

of a communication status in the IP network 9, a function

to analyze the content of the request when the request is

contained in the voice data received from the subscriber

terminal 2A, and a function to control the communication-

status monitor/control section 30 and the communication-

status notification section 40 based on the analyzed

content of the result.

Also, with the arrangement of the request analysis

section 50 as described above, the communication-status

monitor/control section 30 has a function to start or

stop the monitor/control of the communication status

according to the content of a request analyzed by the

request analysis section 50 when the content of the

request is related with starting or stopping of the

monitor/control of the communication status.

Further, with the arrangement of the request analysis section 50 as described above, the communication-status notification section 50 has a function to start or stop the notification of the communication status according to the content of a request analyzed by the request analysis section 40 when the content of the request is related with starting or stopping of the notification of the communication status.

In addition, the communication-status notification apparatus 40 has a function to notify the subscriber terminal of a selected kind of the communication status according to the content of a request analyzed by the request analysis section 50 when the content of the request is related with selecting of a kind of the communication status to be notified.

In order to incorporate VoIP gateway equipment with the functions of the communication-status monitor/control section 30, the communication-status notification section 40 and the request analysis section 50, a recording medium in which a communication-status notification program and associated data are recorded is usually provided and the program and the associated data is installed in the VoIP gateway equipment. The communication-status notification program instructs the computer to function as: communication-status monitoring/controlling means for the same function as the

communication-status monitor/control section 30 (which
means has a function to monitor/control the communication
status of the IP network 9, based on the processing
status of the voice data in the VoIP gateway equipment);
5   communication-status notifying means for the same
function as the communication-status notification section
40 (which means has a function to notifying the
subscriber terminal 2A of the communication status, which
is monitored/controlled by the monitoring/controlling
10 means, via the VoIP gateway equipment 1A); and request
analyzing means for the same function as the request
analysis section 50 (which means has a function to
discriminate whether or not voice data received by the
VoIP gateway equipment 1A from the subscriber terminal 2A
15 contains a request on monitoring/controlling or notifying
of a communication status in the IP network 9, to analyze
the content of a request contained in the voice data
received from the subscriber terminal 2A when the request
is contained in the received voice data, and to control
20 the communication-status monitoring/controlling means and
the communication-status notifying means in response to
the content of the analyzed request).

The installation of the program and the associated
data is performed by setting a storing medium, such as a
25 floppy disk, an MO (Magneto-Optic) disk, a CD-ROM
(compact disk read-only memory), a hard disk or any other
various storing apparatuses, in the computer, or by using

- 60 -

a program provided through the IP network.

FIG. 8 is a block diagram showing the VoIP gateway equipment incorporated with a communication-status notification apparatus according to the first embodiment of the present invention from another angle.

Like the VoIP gateway equipment shown in FIG. 5, the VoIP gateway equipment shown in FIG. 8 is equivalent to, for example, the VoIP gateway equipment 1A in FIG. 1, being equipped with the VoIP-gateway mechanism for transmitting voice data by converting a voice signal into IP packets, and vice versa, and also with the mechanism of notifying the communication status according to the present invention.

Also the VoIP gateway equipment 1A shown in FIG. 8 has components to serve as the VoIP-gateway mechanism: an interface section 11, an audio CODEC section 12, an IP-packet creation/analysis section 13 and a DTMF-signal detector 14. These components have the same functions as those of components designated by like reference numerals in the VoIP gateway equipment 1A shown in FIG. 5: the interface section 11, the audio CODEC section 12, the IP-packet creation/analysis section 13 and the DTMF-signal detection section 14, respectively.

The VoIP gateway equipment 1A shown in FIG. 8 further has components to function as the communication-status notification apparatus according to the present invention: a router-information-notification-request-data

storage / router-information analysis section 31-1, a network-status perceiving / test-data storage section 31-2, a network-status evaluation section 32-1, a bandwidth-alteration request section 33-1, a cryptographic-processing function section 34-1, a cryptographic-processing-control function section 34-2, a cryptographic-processing-status confirmation section 35-1, a cryptographic-processing selection/control function section 36-1, a communication-status storage section 37-1, a message-data-for-service-notification (voice, character and image) storage section 41-1, a command/setting-information-by-DTMF-signal analysis section 51-1 and a service control section 60.

The router-information-notification-request-data storage / router-information analysis section 31-1 has a function combining the functions of the router-information request section 311, the router-information obtaining section 312 and the router-information analysis section 313 of the VoIP gateway equipment 1A shown in FIG. 5.

The network-status perceiving / test-data storage section 31-2 has a function combining the functions of the test-packet-sending control section 314, the test-packet-retrieval control section 315, the test-packet-retrieval analysis section 316 and the test-packet-sending-back control section 317 of the VoIP gateway equipment 1A shown in FIG. 5.

Accordingly, the router-information-notification-
request-data storage / router-information analysis
section 31-1 and the network-status perceiving / test-
data storage section 31-2 are combined to have the same

5   function as that of the traffic-status monitor section 31
of the VoIP gateway equipment 1A shown in FIG. 5.

The network-status evaluation section 32-1 has the
same function as that of the communication-quality
evaluation section 32 of the VoIP gateway equipment 1A

10   shown in FIG. 5.

The bandwidth-alteration request section 33-1 has
the same function as that of the bandwidth-alteration
request section 33 of the VoIP gateway equipment 1A shown
in FIG. 5.

15   The cryptographic-processing function section 34-1
and the cryptographic-processing-control function section
34-2 are combined to have the same function as that of
the cryptographic-processing section 34 of the VoIP
gateway equipment 1A shown in FIG. 5.

20   The cryptographic-processing-status confirmation
section 35-1 has the same function as that of the
cryptographic-processing-status monitor section 35 of the
VoIP gateway equipment 1A shown in FIG. 5.

The cryptographic-processing selection/control

25   function section 36-1 has the same function as that of
the cryptographic-processing selection/control section 36
of the VoIP gateway equipment 1A shown in FIG. 5.

The communication-status storage section 37-1 has the same function as that of the communication-status storage section 37 of the VoIP gateway equipment 1A shown in FIG. 5.

The message-data-for-service-notification (voice, character and image) storage section 41-1 has the same function as that of the notification-material storing section 41 of the VoIP gateway equipment 1A shown in FIG. 5.

The command/setting-information-by-DTMF-signal analysis section 51-1 has the same function as that of the request-information analysis section 51 of the VoIP gateway equipment 1A shown in FIG. 5.

The service control section 60 combines the functions of the communication-status-notification control section 42 and request-receiving control section 52 of VoIP gateway equipment 1A shown in FIG. 5.

Accordingly, the router-information-notification-request-data storage / router-information analysis section 31-1, the network-status perceiving / test-data storage section 31-2, the network-status evaluation section 32-1, the bandwidth-alteration request section 33-1, the cryptographic-processing function section 34-1, the cryptographic-processing-control function section 34-2, the cryptographic-processing-status confirmation section 35-1, the cryptographic-processing selection/control function section 36-1 and the

- 64 -

communication-status storage section 37-1 are combined to
have the same function as that of the communication-
status monitor/control section 30 of the VoIP gateway
equipment 1A shown in FIG. 5.

5   Also, the message-data-for-service-notification
(voice, character and image) storage section 41-1 and the
service control section 60 are combined to have the same
function as that of the communication-status notification
section 40 of the VoIP gateway equipment 1A shown in FIG.

10   5.

        Further, the command/setting-information-by-DTMF-
signal analysis section 51-1 and the service control
section 60 has the same function as that of request
analysis section 50 of the VoIP gateway equipment 1A

15   shown in FIG. 5.

        (ii) Description of Arrangement of Subscriber
Terminal Used in the First Embodiment of the Present
Invention

        Next, an arrangement of a subscriber terminal used

20   in the first embodiment of the present invention will be
described with reference to FIG. 9.

        The subscriber terminal is equivalent to, for
example, the subscriber terminal 2A shown in FIG. 1,
being connected to the VoIP gateway equipment 1A via a

25   PSTN, an ISDN or an exchange so as to carry out
transmission of voice data such as telephone data or
facsimile data via the IP network 9 between another

subscriber terminal 2.

The subscriber terminal shown in FIG. 9 has several components to serve as a voice-transmission function: a voice transmission circuit 21, a voice-data input section 22, a voice-data output section 23, a DTMF-signal control circuit 24 and call notifying means 25.

The voice transmission circuit 21 carries out transmission of a voice signal between VoIP gateway equipment 1A.

The voice-data input section 22 carries out input-processing on a telephone voice or a facsimile image, etc, and converts the inputted telephone voice or facsimile image, etc, into a voice signal including voice data so as to pass the voice signal to the voice transmission circuit 21.

The voice-data output section 23 receives a voice signal from the voice transmission circuit 21, extracts voice data about a telephone voice or a facsimile image, etc, from the voice signal, and converts the extracted voice data into an optimum form such as a telephone voice or a facsimile image, etc, so as to carry out output-processing on the voice data.

The voice-data output section 23 receives notification information as voice from the voice transmission circuit 21 when the voice transmission circuit 21 receives a voice signal containing the notification information in the form of voice, and

carries out output-processing on the notification information.

The DTMF-signal control circuit 24 carries out input-processing on a control signal with dialing operation by a subscriber, and controls the transmission of a voice signal by the voice transmission circuit 21 based on the inputted control signal.

The DTMF-signal control circuit 24 sends the DTMF signal, which was inputted with the dialing operation, to the VoIP gateway equipment 1A in the form of voice signal, using the transmission function of a voice signal in the voice transmission circuit 21.

The call notifying means 25 functions, when the voice transmission circuit 21 receives a voice signal from the VoIP gateway equipment 1A, namely, receives a call, to notifies a subscriber that the call is received by means of voice, character or image.

Also, the call notifying means 25 functions, when the voice transmission circuit 21 receives from the VoIP gateway equipment 1A a voice signal containing notification information in the form of voice, character or image as voice data, as controlling the voice transmission circuit 21 to detect the notification information contained in the received voice signal, and as notifying the notification information by means of the voice, character and image.

If the subscriber terminal 2A is a telephone, the

voice-data input section 22 and the voice-data output

section 23 are devoted mainly to input/output process of

telephone voice data and, if the subscriber terminal 2A

is a facsimile machine, the voice-data input section 22

5   and the voice-data output section 23 are devoted mainly

to input/output process of facsimile image data.

It is also possible that in the subscriber terminal

2A, the voice-data input section 22 and the voice-data

output section 23 may combine the input/output-processing

10   function of telephone voice and the input/output-

processing function of facsimile image data.

(iii) Description of Arrangement of Router Used in

the First Embodiment of the Present Invention

Then, an arrangement of a router used in the first

15   embodiment of the present invention will be described

with reference to FIG. 10.

As described above, the router 90 exists in the IP

network 9 shown in FIG. 1 as a component of the IP

network 9, for transmitting IP packets containing voice

20   data, which is sent/received by plural subscriber

terminals 2 each connected to the IP network 9 via VoIP

gateway equipment 1, and also for controlling the routing

of the IP packets in association with the transmission of

the IP packets, so that the plural subscriber terminals 2

25   can interchange the IP packets.

The router 90 shown in FIG. 10 has several

components to serve as the router function: an IP-packet

transmission section 91, a traffic-information
monitor/control section 92 and an IP-packet-transmission-
path selection/control section 93.

The IP-packet transmission section 91
sends/receives IP packets to/from another router 90 or
VoIP gateway equipment connected to the router 90.

The traffic-information monitor/control section 92
monitors various kinds of traffic status of IP packets
sent/received by the IP-packet transmission section 91,
such as a sending/receiving status of IP packets, a
congestion status of IP packets, a missing/retransmitting
status of IP packets and a ratio of current throughput of
IP packets to maximum throughput of IP packets.

The traffic-information monitor/control section 92
creates an IP packet containing traffic information
monitored in the router 90 and controls the IP-packet
transmission section 91 to send the created IP packet to
another router 90 in the IP network 9. Also, when the
IP-packet transmission section 91 receives from another
router an IP packet containing traffic information
monitored in the other routers 90 in the IP network 9,
the traffic-information monitor/control section 92
obtains the traffic information of the other router 90
from the received IP packet and storing the traffic
information.

Further, when the IP-packet transmission section 91
receives an information-request IP packet, which includes

a request signal to notify information about traffic
status, from VoIP gateway equipment connected to the IP
network, the traffic-information monitor/control section
92 creates an IP packet containing traffic information,
which was monitored in the router 90, and controls the
IP-packet transmission section 91 to send the created IP
packet to the VoIP gateway equipment, from which the
information-request IP packet was sent.

Also, when the IP-packet transmission section 91
receives a bandwidth-alteration request IP packet, which
includes a request signal to alter a bandwidth to be used
for voice data, from VoIP gateway equipment connected to
the IP network, the traffic-information monitor/control
section 92 controls the IP-packet transmission section 91
to alter a bandwidth to be used for voice data in
response to the request.

IP-packet-transmission-path selection/control
section 93 determines a transmission path of an IP packet,
which is received by the IP-packet transmission section
91, based on a destination address included in a header
of the IP packet, with reference to both of traffic
information of IP packets in the router 90, which
information is monitored by the traffic-information
monitor/control section 92, and traffic information of IP
packets in one or more other routers 90, which
information is stored by the traffic-information
monitor/control section 92.

Also the traffic-information monitor/control section 92 monitors information about controlling of transmission path in the IP-packet-transmission-path selection/control section 93 as traffic information.

5   (1-2) Description of Notifying Operation of Traffic Status in the First Embodiment of the Present Invention:

Next, the description will be made on various kinds of operation in the VoIP communication system of the first embodiment of the present invention, specifically

10   on monitoring/controlling operation and notifying operation of a traffic status in an IP network by the communication-status notification apparatus, with reference to FIGs. 11-13.

In the following description, the traffic status in

15   an IP network genetically means various kinds of communication status that may affect voice quality, such as traffic of IP packets, congestion status of IP packets and delay times of IP packets.

In the VoIP communication system according to the

20   first embodiment of the present invention, the following four kinds of operations are performed as monitoring/controlling and notifying operations of a traffic status by the communication-status notification apparatus.

25   (i) operation of monitoring a traffic status in the IP network 9 by the VoIP gateway equipment (monitoring operation of a traffic status)

(ii) operation of notifying a subscriber terminal of information about a traffic status and voice-call quality by the VoIP gateway equipment (notifying operation of a communication status)

5   (iii) operation of analyzing a request on monitoring, controlling or notifying of a traffic status and voice-call quality, which request was sent from a subscriber terminal, and operation of controlling the monitor, control or notification of the traffic status

10   and voice-call quality by the VoIP gateway equipment in response to the content of the request (responding operation to a communication-status request)

       (iv) operation of requesting a router by the VoIP gateway equipment to alter a bandwidth allocated to voice

15   data in the router (requesting operation of bandwidth-alteration)

       These operations will now be described below in turn.

       (i) Description of Monitoring Operation of Traffic

20   Status

       First, operation of monitoring the traffic status of the IP network by the VoIP gateway equipment, which is incorporated with the communication-status notification apparatus of the present invention, will be described

25   with reference to FIG. 11.

       As shown in FIG. 11, two sets of VoIP gateway equipment 1A, 1A' are connected to an IP network 9, which

includes a router 90. Each of the sets of VoIP gateway
equipment 1A, 1A' is incorporated with the communication-
status notification apparatus of the present invention,
which apparatus has the arrangement as shown in FIG. 5,
and is also connected with a respective one of subscriber
terminals 2A, 2A'.

The following description will be concentrated on
operation by the VoIP gateway equipment 1A and operation
by the subscriber terminal 2A.

The VoIP gateway equipment 1A with the
communication-status notification apparatus carries out
the monitoring operation of the traffic status of the IP
network by the following two measures.

① a measure using information collected from
routers in the IP network

② a measure using a retrieving status of test IP
packets from other VoIP gateway equipment

These two measures will now be described in turn.

① the measure using information collected from
routers in the IP network

This is a measure in which the VoIP gateway
equipment 1A with the communication-status notification
apparatus requests the router 90 in the IP network 9 to
send information about a traffic status, and monitors the
traffic status based on the information obtained from the
router 90.

First, the VoIP gateway equipment 1A with the

communication-status notification apparatus sends to the router 90 a signal requesting the router 90 to send information about traffic status to the VoIP gateway equipment 1A (Step A1).

5   Concretely, the traffic-status monitor section 31 controls the IP-packet creation/analysis section 13 to create an information-request IP packet, which contains a signal requesting to notify the VoIP gateway equipment 1A of information about the traffic status, and then to send

10   the created information-request IP packet over the IP network 9 toward the router 90 in the IP network 9.

The traffic-status information to be requested by the traffic-status monitor section 31 means various kinds of information monitored by the traffic-information

15   monitor/control section 92 of the router 90 during the normal operation of the router 90, including a sending/receiving status of IP packets, a congestion status of IP packets, a missing/retransmitting status of IP packets, a ratio of current throughput of IP packets

20   to maximum throughput of IP packets and a number of IP packets accumulated in a buffer of the router 90, etc.

Next, receiving the information-request IP packet sent from the VoIP gateway equipment 1A, the router 90 in the IP network 9 sent the information about traffic

25   status to the VoIP gateway equipment 1A, in response to the content of request contained in the received information-request IP packet (Step A2).

Concretely, when the IP-packet transmission section
91 of the router 90 receives the information-request IP
packet from the VoIP gateway equipment 1A, the traffic-
information monitor/control section 92 creates an IP
packet containing information about the traffic-status
monitored by the router 90, and controls the IP-packet
transmission section 91 to send the created IP packet to
the VoIP gateway equipment 1A, from which the
information-request IP packet was sent.

Finally, the VoIP gateway equipment 1A receives the
traffic-status information sent from the router 90 and
monitors the traffic status of the IP network 9 based on
the received information.

Concretely, the traffic-status monitor section 31
obtains the traffic-status information, which was sent
from the router 9 in the IP network 9, out of IP packets
received from the router 90 by the IP-packet
creation/analysis section 13, and analyzes the traffic
status of the IP network 9 based on the obtained traffic-
status information.

According to the measure ① as described above, the
VoIP gateway equipment 1A can monitor the traffic status
of the IP network 9 with a simple arrangement while
utilizing the sending/receiving function of IP packets,
which is equipped with the conventional VoIP gateway
equipment, by analyzing the traffic status based on
various kinds of information sent from the router 90 in

the IP network, such as the sending/receiving status of
IP packets, the congestion status of IP packets, the
missing/retransmitting status of IP packets, the ratio of
current throughput of IP packets to maximum throughput of
5   IP packets and the number of IP packets accumulated in a
buffer of the router 90, etc.

② the measure using a retrieving status of test IP
packets from other VoIP gateway equipment

This is a measure in which the VoIP gateway
10   equipment 1A with the communication-status notification
apparatus sends one or more test IP packets to other VoIP
gateway equipment 1A', which is connected to the IP
network 9, and monitors the traffic status based on a
retrieving status of the test IP packets, which was sent
15   back from the other VoIP gateway equipment 1A'.

First, the VoIP gateway equipment 1A with the
communication-status notification apparatus sends test IP
packets to other VoIP gateway equipment 1A' connected to
the IP network 9 (Step B1).

20   Concretely, the traffic-status monitor section 31
controls the IP-packet creation/analysis section 13 to
create one or more test IP packets and sends the created
test IP packet over the IP network 9 toward other VoIP
gateway equipment 1A', which is connected to the IP
25   network 9 and serves as a companion to the VoIP gateway
equipment 1A for data transmission.

As described above, each of the test IP packets

- 76 -

contains a signal requesting the companion VoIP gateway

equipment 1A' to send back the test IP packets to the

VoIP gateway equipment from which the test IP packets

were sent (namely, the VoIP gateway equipment 1A) in

5   response to the receiving of the test IP packets.

Next, the other VoIP gateway equipment 1A'

connected to the IP network 9 sends the test IP packets,

which were received from the VoIP gateway equipment 1A,

back to the VoIP gateway equipment 1A (Step B2).

10   Concretely, in the VoIP gateway equipment 1A'

connected to the IP network 9, the test-packet-sending-

back control section 317 controls the IP-packet

creation/analysis section 13 to detect an individual test

IP packet, which was sent from other VoIP gateway

15   equipment connected to the IP network (in the present

instance as shown in FIG. 11, the individual test IP

packet sent from the VoIP gateway equipment 1A), out of

IP packets received from the IP network 9 by the IP-

packet creation/analysis section 13, and send back the

20   received individual test IP packet to the VoIP gateway

equipment from which the test IP packet was sent (namely,

the VoIP gateway equipment 1A) in response to the signal

contained in the individual test IP packet.

Next, the VoIP gateway equipment 1A receives the

25   individual test IP packet, which was sent back from the

other VoIP gateway equipment 1A' connected to the IP

network 9, and analyzes the traffic status of the IP

network 9 based on the retrieving status of the test IP
packets.

Concretely, the traffic-status monitor section 31
of the VoIP gateway equipment 1A detects the test IP
packet, that was first sent from the VoIP gateway
equipment 1A and then sent back from other VoIP gateway
equipment connected to the IP network 9 (in the present
instance, the VoIP gateway equipment 1A'), out of IP
packets received by the IP-packet creation/analysis
section 13 to retrieve the detected test IP packet, and
monitors a retrieving status of the test IP packets
originally sent from the VoIP gateway equipment 1A. The
traffic-status monitor section 31 then analyzes the
traffic status of the IP network based on the monitored
retrieving status of the test IP packets.

According to the measure ② as described above, the
VoIP gateway equipment 1A can perceive the traffic status
of the IP network 9 with a simple arrangement while
utilizing the sending/receiving function of IP packets,
which is equipped with the conventional VoIP gateway
equipment, by analyzing the traffic status based on the
retrieving status of the test IP packets sent back from
the other VoIP gateway equipment 1A' connected to the IP
network 9.

For example, by analyzing how much time has passed
since the VoIP gateway equipment 1A sent the IP packets
to the other VoIP gateway equipment 1A' and until the

VoIP gateway equipment 1A receives the test IP packets

sent back from the VoIP gateway equipment 1A', the VoIP

gateway equipment 1A can monitor delay times for IP

packets to go to and return from the companion VoIP

5   gateway equipment 1A'.

Also, by sending successive test IP packets having

the sequential numbers to the other VoIP gateway

equipment 1A' and by analyzing the sequential numbers of

the successive test IP packets sent back from the other

10   VoIP gateway equipment 1A', the VoIP gateway equipment 1A

can calculate a ratio of a number of missing test IP

packets to a number of the originally-sent successive

test IP packets, thereby monitoring a missing status of

IP packets in the IP network 9.

15   As described above, by using the measures ① and ②,

the VoIP gateway equipment 1A with the communication-

status notification apparatus can monitor the congestion

status and the missing status of IP packets, which were

monitored by the router 90 in the IP network 9, and also

20   monitor the delay times and the missing status of IP

packets between the other VoIP gateway equipment 1A'

connected to the IP network 9

Further, the VoIP gateway equipment 1A evaluates

communication quality of voice communication over the IP

25   network 9, based on the traffic status of the IP network

monitored by use of the means ① and ②.

Concretely, using the traffic status of the IP

network 9 monitored by the traffic-status monitor section
31, specifically the congestion status of voice data in
the IP network 9, the communication-quality evaluation
section 32 carries out the evaluation of the
5   communication quality of voice data over the IP network 9.

Finally, the communication-status storage section
37 stores, as information about a communication status,
the traffic status of the IP network 9 monitored by the
traffic-status monitor section 31 and the communication
10 quality of voice communication evaluated by the
communication-quality evaluation section 32.

(ii) Description of Notifying Operation of
Communication Status

Next, operation of notifying a subscriber terminal
15 of information about the traffic status and the
communication quality by the VoIP gateway equipment,
which is incorporated with the communication-status
notification apparatus of the present invention, will be
described with reference to FIG. 12.

20   As shown in FIG. 12, like FIG. 11, two sets of VoIP
gateway equipment 1A, 1A' are connected to an IP network
9, which includes a router 90. Each of the sets of VoIP
gateway equipment 1A, 1A' is incorporated with the
communication-status notification apparatus of the
25 present invention, which apparatus has the arrangement as
shown in FIG. 5. One set of VoIP gateway equipment 1A is
also connected with a subscriber terminal 2A.

The VoIP gateway equipment 1A notifies the subscriber terminal 2A, connected to the VoIP gateway equipment 1A, of the traffic status of voice data in the IP network and the communication quality for voice communication over the IP network, which items were monitored by the Monitoring Operation of Traffic Status as described above, as the communication status monitored/controlled by the communication-status monitor/control section 30 (Step C1).

Concretely, the communication-status-notification control section 42 controls the interface section 11 to notify the subscriber terminal 2A of information about the monitored traffic status in the IP network 9 and the evaluated communication quality of voice communication, both stored in the communication-status storage section 37, using notification materials stored in the notification-material storing section 41.

The communication-status-notification control section 42 selects a notification material from the notification materials stored in the notification-material storing section 41, such as voice, character and image, according to both a kind of subscriber terminal 2A to be notified to, which kind has been identified by controlling the interface section 11, and a kind of communication status to be notified of, and then carries out the notification of the traffic status using the selected material.

Concretely, the selection of notification material is made from two options, according to a kind of the subscriber terminal 2A: namely, ① notification using voice, and ② notification using character and/or image.

① notification using voice

If the subscriber terminal 2A to be notified is an ordinary subscriber terminal (especially a telephone) used for voice communication, especially a subscriber terminal connected to a PSTN, the communication-status-notification control section 42 notifies the subscriber terminal 2A of the communication status using voice material from the notification materials stored in the notification-material storing section 41.

The communication-status-notification control section 42 chooses two measures to notify of the communication status according to a kind of the communication status to be notified; namely, a measure to transmit a voice message at an optimum level over a voice call to the subscriber, and a measure to interrupt a voice talk of the subscriber with connection kept established for a moment while transmitting a voice message to the subscriber.

If the subscriber terminal 2A to be notified is a telephone, for example, and if the information to be notified is about the evaluated communication quality, the communication-status-notification control section 42 transmits an alarm such as a bleep over a telephone voice

during a voice call, at a low level so as not to disturb the voice call.

② notification using character and/or image

Assume that the subscriber terminal 2A to be notified is a terminal having a function of, when the call notifying means 25 receives a voice signal including any notification material such as a material of character and/or image from the VoIP gateway equipment 1A, controlling the voice transmission circuit 21 to detect the notification material from the received voice signal and carrying out the notification using the character and/or image associated with the notification material, specifically a terminal which is connected to an ISDN and can receive a digital signal and a terminal which has a function to create/analyze an IP packet. To such a terminal, the communication-status-notification control section 42 notify of the communication status using a character material or an image material from the notification materials stored in the notification-material storing section 41.

Concretely, the call notifying means 25 of the subscriber terminal 2A sends an appropriate notification material to the subscriber terminal 2A according to a kind of the subscriber terminal 2A so that the information about the communication status is displayed in the form of a message of character and/or image.

The communication-status-notification control

section 42 chooses an appropriate notifying measure
according to a kind of communication-status information
to be notified. Here two cases will be described: ③
where information about the traffic status of the IP
network is notified, and ④ where information about the
communication quality of the IP network is notified.

③ the case where information about the traffic
status of the IP network is notified

On notifying information about a current traffic
status in the IP network 9, the communication-status-
notification control section 42 notifies the subscriber
terminal 2A of the current traffic status of the IP
network 9 using a notification material, which includes a
message indicating the current traffic status as an index
easily perceivable by the subscriber of the terminal 2A.

For example, on notifying of traffic at the router
90 in the IP network, the communication-status-
notification control section 42 represents the traffic at
the router 90 as a percentage of a current throughput of
IP packets in the router 9 to a maximum throughput of IP
packets in the router 9 and notifies of the traffic with
a notification material in the form of a message such as
"The current traffic in the network is about 20%,
current voice-call quality is fine." or "The network is
very congested so that it is difficult to secure enough
voice-call quality." In this example, an appropriate
material is selected from voice, character and image so

as to express the message according to a kind of the subscriber terminal 2A.

As described above, because the traffic status of the IP network 9 is monitored and notified of to the subscriber terminal 2A, the subscriber can observe the traffic status of the IP network 9 easily via the subscriber's own terminal.

④ the case where information about the communication quality of the IP network is notified

On notifying information about a current communication quality in the IP network 9, the communication-status-notification control section 42 notifies the subscriber terminal 2A of the current communication quality of the IP network 9 using a notification material, which includes a message indicating the current communication quality as an index easily perceivable by the subscriber of the terminal 2A.

For example, when the communication-quality evaluation section 32 evaluates a current voice-call quality in the IP network as not fine, the communication-status-notification control section 42 notifies of information about the result of the evaluation (the evaluated voice-call quality) using a notification material in the form of a message such as "The network is very congested so that it is difficult to secure enough voice-call quality." Also in this example, an appropriate material is selected from voice, character

and image so as to express the message according to a kind of the subscriber terminal 2A.

If the subscriber terminal 2A to be notified is a telephone which can manage only voice data and when voice-call quality is evaluated as getting worse during a voice call, the communication-status-notification control section 42 notifies subscriber terminal 2A of information about the result of the evaluation by transmitting a notification material of an alarm such as a bleep to the subscriber terminal 2A over a telephone voice during a voice call, at a low level so as not to disturb the voice call.

Accordingly, because the communication quality of voice data in the IP network 9 is evaluated based on monitored the traffic status in the IP network 9 and the result of evaluation is notified of to the subscriber terminal, the subscriber can observe the communication quality of voice data in the IP network 9 easily via the subscriber's own terminal.

As described above with reference to the options ①-④, the communication-status-notification control section 42 chooses an appropriate notification material from notification materials (voice, character and image) stored in the notification-material storing section 41, according to both a kind of subscriber terminal 2A to be notified to and a kind of the communication-status information to be notified of, and carries out the

-86-

notification using the selected notification material.

Particularly when the subscriber terminal 2A is a telephone which can manage only voice data, the communication-status-notification control section 42 chooses a measure to transmit a voice message at an optimum level over a voice call to the subscriber terminal 2A, as exemplified in the description ④, and a measure to interrupt a voice talk of the subscriber with connection kept established for a moment while transmitting a voice message to the subscriber terminal 2A, according to a kind of the communication-status. With this arrangement, it is possible to notify a communication status with voice more clear, according to a kind of the communication status.

Regarding frequency of the notifying operation of the communication status subscriber terminal 2A, the communication-status-notification control section 42 also chooses an appropriate option according to a kind of the communication-status from the following three options: to notify periodically, to notify in response to the result of the monitor/control of the communication status, and to notify in response to a request sent from the subscriber terminal 2A.

As descried above, because the communication status of the IP network 9 is clearly notified of to the subscriber terminal 2A with material such as voice, character and image, the subscriber can easily perceive

various kinds of communication status of the IP network 9 more clearly.

(iii) Description of Responding Operation of Communication-Status Request

Next, operation of analyzing a request on monitoring/controlling or notifying a traffic status and voice-call quality sent from a subscriber terminal by VoIP gateway equipment, which is incorporated with the communication-status notification apparatus according to the present invention, and operation of controlling the monitoring/controlling or notifying of traffic status and voice-call quality in response to the content of the request, will be described with reference to FIG. 13.

As shown in FIG. 13, two sets of VoIP gateway equipment 1A, 1A' are connected to an IP network 9, which includes a router 90. Each of the sets of VoIP gateway equipment 1A, 1A' is incorporated with the communication-status notification apparatus of the present invention, which apparatus has the arrangement as shown in FIG. 5. One set of VoIP gateway equipment 1A is also connected with a subscriber terminal 2A.

Assume that the subscriber terminal 2A connected with the VoIP gateway equipment 1A sends to the VoIP gateway equipment 1A a request for starting/stopping or selecting in relation with monitoring of the traffic status and evaluating of the communication quality, which is carried out by the monitoring operation of traffic

described in the above (i), and notifying of the traffic status and the communication quality, which is carried out by the notifying operation of communication status described in the above (ii), in the form of a voice signal. The VoIP gateway equipment 1A analyzes the content of the request by the function of the request analysis section 50, and carries out the monitoring/controlling or notifying of communication status in response to the request (Step D1).

Specific processes will be described below.

First, the subscriber operates the DTMF-signal control circuit 24 of the subscriber terminal 2A in a predetermined sequence, thereby control the subscriber terminal 2A to send a DTMF signal corresponding to a desired request. One or more DTMF signals are previously defined to be associated with one or more request, respectively, so that the subscriber can generated each of the DTMF signals by a specific and simple DTMF-signal operation of the subscriber terminal (for example, dialing in turns of #, #, #, 1, 0) and that the subscriber can easily memorize the DTMF-signal operation corresponding to each of the DTMF signals.

Next, in the VoIP gateway equipment 1A, the DTMF-signal detection section 14 detects a DTMF signal based on any DTMF-signal operation out of voice signals received by the interface section 11.

Further, the request-information analysis section

51 analyzes the DTMF signal detected by the DTMF-signal detection section 14 and recognizes the desired request corresponding to the DTMF signal.

In response to the request analyzed in the above-described way, the request-receiving control section 52 controls both the operation of monitoring/controlling the communication status by the communication-status monitor/control section 30 or the operation of notifying of the communication status by the communication-status notification section 40.

Namely, in response to a request based on the specific DTMF-signal operation, the request-receiving control section 52 carries out control such as starting or stopping of the operation of analyzing the traffic status of the IP network 9 by the traffic-status monitor section 31 or the operation of evaluating the communication quality of the IP network 9 by the communication-quality evaluation section 32.

Also, when the content of the request is related with the notification of the traffic status or the communication quality, the request-receiving control section 52 controls the communication-status-notification control section 42 to notify the subscriber terminal 2A via the interface section 11 of various kinds of information stored in the communication-status storage section 37, namely, the information about the traffic status monitored by the traffic-status monitor section 31

-90-

and the information about the communication quality
evaluated by the communication-quality evaluation section
32 (Step D2).

The request-information analysis section 51
continuously discriminates whether or not DTMF signals
detected by the DTMF-signal detection section 14 include
a DTMF signal corresponding to a request on
monitoring/controlling or notifying of the communication
status from the subscriber terminal and, when there is a
DTMF signal corresponding to any request, analyzes the
content of the request. With this arrangement, the
subscriber can control monitoring/controlling or
notifying of the communication status actively by
carrying out a specific DTMF-signal operation.

(iv) Description of Requesting Operation of
Bandwidth Alteration

Finally, operation of requesting the router to
alter a bandwidth to be allocated to voice data by the
VoIP gateway equipment, which is incorporated with the
communication-status notification apparatus according to
the present invention, will be described with reference
to FIG. 13.

By carrying out the monitoring operation of the
traffic status as described in (i), the VoIP gateway
equipment 1A monitors the traffic status in the IP
network 9 at regular intervals. When it is evaluated
difficult to secure adequate communication quality based

on the result of monitoring, because of decline of a
throughput of IP packets due to deterioration of the
traffic status of voice data, the VoIP gateway equipment
1A sends to the router 90 in the IP network 9 a request
for altering a bandwidth to be allocated to voice data
(Step E1).

Concretely, the monitoring operation of the traffic
status as described in the above (i), the communication-
quality evaluation section 32 first evaluates the
communication quality for voice communication over the IP
network 9 based on the result of the analyzing of the
traffic status of the IP network 9 by the traffic-status
monitor section 31, especially the congestion status of
voice data in the IP network 9.

When the communication-quality evaluation section
32 evaluates that the communication quality of voice data
in the IP network 9 is lower than a predetermined level,
the bandwidth-alteration request section 33 controls the
IP-packet creation/analysis section 13 to create a
bandwidth-alteration request IP packet which contains a
signal requesting the router to broaden a bandwidth to be
used for voice data, and sends the created bandwidth-
alteration request IP packet over the IP network 9 toward
the router 90 in the IP network 9.

Also when the communication-quality evaluation
section 32 evaluates that the communication quality of
voice data in the IP network 9 is higher than a

predetermined level, the bandwidth-alteration request

section 33 controls the IP-packet creation/analysis

section 13 to create a bandwidth-alteration request IP

packet which contains a signal requesting the router to

5   narrow a bandwidth to be used for voice data, and sends

the created bandwidth-alteration request IP packet over

the IP network 9 toward the router 90 in the IP network 9.

Next, the router 90 in the IP network 9 alters the

bandwidth used for voice data in response to the request

10   contained in the bandwidth-alteration request IP packets

received from the VoIP gateway equipment 1A.

Concretely, when the IP-packet transmission section

91 receives a bandwidth-alteration request IP packet,

which contains a signal requesting the router to alter a

15   bandwidth to be used for voice data, from VoIP gateway

equipment connected to the IP network 9 (in the present

embodiment, the VoIP gateway equipment 1A), the traffic-

information monitor/control section 92 controls the IP-

packet transmission section 91 to alter the bandwidth to

20   be used for voice data in response to the request.

With this arrangement as described above, the

subscriber takes measures to improve the communication

quality of voice data easily via the subscriber's own

terminal, and effectively uses the bandwidth allocated by

25   the router according to the communication quality of

voice data.

It is also possible to arrange that the

communication-quality evaluation section 32 calculates a

required bandwidth based on the traffic status monitored

by the traffic-status monitor section 31, and inserts

information about the required bandwidth into an IP

5   packet created by the IP-packet creation/analysis section

13.

As described above, according to the VoIP gateway

equipment incorporated with the communication-status

notification apparatus according to the present invention,

10   because the VoIP gateway equipment performs (i) the

monitoring operation of the traffic status, (ii) the

notifying operation of the communication status, (iii)

the responding operation to a communication-status

request and (iv) the requesting operation of bandwidth-

15   alteration, the subscriber can perceive the traffic

status or the communication quality of the IP network at

any time before or during voice communication.

Also, when it becomes difficult to secure adequate

communication quality during a voice call, the subscriber

20   can perceive the decline of the communication quality

from the notification by the VoIP gateway equipment.

Further, the subscriber can set/reset the

monitoring/controlling or notifying of the communication

status at any time by performing a DTMF-signal operation.

25   (1-3) Description of Notifying Operation of the

Cryptographic-Processing Status in the First Embodiment

of the Present Invention:

Next, a description will be made successively on various kinds of operation in the VoIP communication system according to the first embodiment of the present invention, specifically on monitoring/controlling

5   operation and notifying operation of a cryptographic-processing status of voice data by the communication-status notification apparatus, with reference to FIG. 14.

In the following description, the cryptographic-processing status is not limited to a specific technology

10   such as the cryptography, but genetically means various kinds of status related with setting/resetting or selecting of various kinds of cryptographic processing carried out over the IP network 9.

In the VoIP communication system according to the

15   first embodiment of the present invention, the following four kinds of operations are performed as monitoring/controlling and notifying operations of the cryptographic-processing status by the communication-status notification apparatus.

20   (i) operation of cryptographic-processing voice data by the VoIP gateway equipment (monitoring/controlling operation of a cryptographic-processing status)

(ii) operation of notifying the subscriber terminal

25   of information about the cryptographic-processing status by the VoIP gateway equipment (responding operation to a communication-status request)

-95-

(iii) operation of analyzing a request on monitoring/controlling or notifying of the cryptographic-processing status sent from the subscriber terminal, and operation of controlling the monitoring/controlling or notifying of the cryptographic-processing status in response to the content of the request, by the VoIP gateway equipment (responding operation to a communication-status request)

(iv) operation of monitoring a cryptographic-processing status in other VoIP gateway equipment by the VoIP gateway equipment (monitoring operation of cryptographic-processing status)

These operations will now be described in order.

(i) Description of Monitoring/Controlling Operation of Cryptographic-Processing Status

First, operation of cryptographic-processing voice data by VoIP gateway equipment, which is incorporated with the communication-status notification apparatus of the present invention, will be described.

In the VoIP gateway equipment 1A, the communication-status monitor/control section 30 carries out a cryptographic-process on voice data sent to / received from the IP network 9.

Concretely, when voice data is received from the subscriber terminal by the interface section 11 and compression-processed by the audio CODEC section 12, the cryptographic-processing section 34 carries out a

cryptographic process on the voice data, so that the IP-packet creation/analysis section 13 then carries out IP-packetization of the voice data to send the IP-packetized voice data to the IP network 9.

5   Also, when IP packets are transmitted from the IP network 9 and analyzed by the IP-packet creation/analysis section 13 to extract voice data contained in the IP packets, the cryptographic-processing section 34 resets the cryptographic process carried out on the voice data,

10   so that the audio CODEC section 12 decompression-processes the voice data to send the decompression-processed voice data via the interface section 11 to the subscriber terminal.

The cryptographic-processing section 34 can choose

15   at least one of a scramble process, an encryption process and an interleave process to carry out the chosen process as the cryptographic process on voice data.

Concretely, the cryptographic-processing section 34 has at least one of a specific rule to carry out the

20   scramble process, a specific key for encryption/decryption to carry out the encryption process and a specific rule to carry out the interleave process.

Also, the monitor/control of the cryptographic-processing status, such as the selection of a kind of the

25   cryptographic process carried out in the cryptographic-processing section 34 and the start/stop of the cryptographic-process, is performed by the cryptographic-

-97-

processing selection/control section 36.

Further, the result of the monitoring/controlling of the cryptographic-processing status by the cryptographic-processing selection/control section 36 is stored in the communication-status storage section 37 as required.

(ii) Description of Responding Operation to Communication-Status Request

Next, operation of notifying the subscriber terminal of cryptographic-processing status by the VoIP gateway equipment, which is incorporated with the communication-status notification apparatus of the present invention, will be described with reference to FIG. 14.

Also as shown in FIG. 14, two sets of VoIP gateway equipment 1A, 1A' are connected to an IP network 9, which includes a router 90. Each of the sets of VoIP gateway equipment 1A, 1A' is incorporated with the communication-status notification apparatus of the present invention, which apparatus has the arrangement as shown in FIG. 5, and is also connected with a respective one of the subscriber terminals 2A, 2A'.

This operation is generally similar to the notifying operation of communication status described in the above (ii) of the description (1-2) about notifying operation of traffic status.

Namely, the VoIP gateway equipment 1A notifies the

subscriber terminal 2A, which is connected to the VoIP
gateway equipment 1A, of the result of the
monitoring/controlling of the cryptographic-processing
status by the cryptographic-processing selection/control
section 36, as information about the communication status
monitored/controlled by the communication-status
monitor/control section 30 (Step F1).

Concretely, the communication-status-notification
control section 42 controls the interface section 11 to
notify the subscriber terminal 2A of information about
the result of the monitoring/controlling of the
cryptographic-processing status, which is stored in the
communication-status storage section 37, using the
notification materials stored in the notification-
material storing section 41.

The communication-status-notification control
section 42 chooses at least one material from the
notification materials of voice, character and image
stored in the notification-material storing section 41,
according to both a kind of subscriber terminal 2A to be
notified, which kind is identified by controlling the
interface section 11, and a kind of the communication-
status information to be notified, and carries out the
notification using the chosen notification materials.

(iii) Description of Responding Operation to
Communication-Status Request

Next, operation of analyzing the content of a

-99-

request on monitoring/controlling or notifying of the

communication status sent from the subscriber terminal,

and operation of controlling the monitoring/controlling

or the notifying of communication status in response to

5   the content, by the VoIP gateway equipment, which is

incorporated with the communication-status notification

apparatus according to the present invention, will be

described.

This operation is generally similar to the

10   responding operation of communication-status request in

the above (iii) of the description (1-2) about notifying

operation of traffic status.

Namely, the subscriber terminal 2A connected to the

VoIP gateway equipment 1A sends to the VoIP gateway

15   equipment 1A a request for starting, stopping or

selecting in the form of voice signal in relation with

the monitor/control of the cryptographic-processing

status as described in the above (i) or notification of

the cryptographic-processing status by notifying

20   operation of a communication status described in the

above (ii) (Step G1).

Then, the content of the request is analyzed by the

function of the request analysis section 50, and the

monitoring/controlling or the notifying of the

25   communication status is carried out in response to the

request (Step G2).

(iv) Description of Monitoring Operation of

Cryptographic-Processing Status

Finally, operation of monitoring a cryptographic-processing status in other VoIP gateway equipment by the VoIP gateway equipment, which is incorporated with the communication-status notification apparatus according to the present invention, will be described with reference to FIG. 14.

In order that the subscriber terminals 2A, 2A' send/receive voice data, on which the scramble process, the encryption process or the interleave process is carried out, to/from each other, the two sets of VoIP gateway equipment 1A, 1A', to which the subscriber terminals 2A, 2A' are respectively connected, need to have common rules for the scramble process, common keys for the encryption process and common rules for the interleave process.

Accordingly, the VoIP gateway equipment 1A with the communication-status notification apparatus has a function to discriminate whether or not other VoIP gateway equipment 1A', which serves as a companion with the VoIP gateway equipment 1A for voice data transmission, can exchange voice data on which a cryptographic process is carried out with the VoIP gateway equipment 1A, namely, whether or not the companion VoIP gateway equipment 1A' has a common rule for the scramble process, a common key for the encryption process and a common rule for the interleave process to the VoIP gateway equipment 1A.

- 101 -

The monitoring operation of a cryptographic-processing status is mainly carried out by the cryptographic-processing monitoring section 35 of each of the sets of VoIP gateway equipment 1A, 1A'.

Concretely, in the VoIP gateway equipment 1A, the cryptographic-processing-information request section 351 controls the IP-packet creation/analysis section 13 to create a cryptographic-processed-data IP packet, containing data on which one of the scramble process, the encryption process and the interleave process was carried out, and a cryptographic-processing-request IP packet, containing a signal requesting the companion VoIP gateway equipment 1A' to decipher the cryptographic-processed data and to send the deciphered data back, and sends the cryptographic-processed-data IP packet and the cryptographic-processing-request IP packet over the IP network 9 toward the companion VoIP gateway equipment 1A' connected to the IP network 9 (Step H1).

Next, in the companion VoIP gateway equipment 1A', the cryptographic-processing-information sending section 354 controls the IP-packet creation/analysis section 13 to discriminate the cryptographic-processed-data IP packet and the cryptographic-processing-request IP packet, both of which were sent from other VoIP gateway equipment 1A connected to the IP network 9, out of IP packets received from the IP network 9 by the IP-packet creation/analysis section 13. Then the cryptographic-

processing-information sending section 354 deciphers the cryptographic-processed data contained in the cryptographic-processed-data IP packet in response to a signal contained in the cryptographic-processing-request

5   IP packet. Subsequently, the cryptographic-processing-information sending section 354 further controls the IP-packet creation/analysis section 13 to create an IP packet containing the result of the decipher of the cryptographic-processed data, and to send the created IP

10   packet to the companion VoIP gateway equipment 1A, from which the cryptographic-processed-data IP packet and the cryptographic-processing-request IP packet was sent (Step H2).

       In the VoIP gateway equipment 1A, the

15   cryptographic-processing-information obtaining section 352 controls the IP-packet creation/analysis section 13 to obtain the result of the decipher (deciphered data or decoded data) of the cryptographic-processed data, which was sent from the companion VoIP gateway equipment 1A'

20   connected to the IP network 9 in response to the cryptographic-processed-data IP packet and the cryptographic-processing-request IP packet, out of IP packets received from the IP network 9 and depacketized by the IP-packet creation/analysis section 13. The

25   cryptographic-processing-information analysis section 353 then analyzes a cryptographic-processing status in the companion VoIP gateway equipment 1A' based on the result

of the decipher by the companion VoIP gateway equipment 1A', which was obtained by the cryptographic-processing-information obtaining section 352.

Finally, the cryptographic-processing monitoring section 35 chooses one of the following three measures according to a kind of the cryptographic process carried out by the cryptographic-processing section 34, thereby carrying out the operation of monitoring the cryptographic-processing status in the companion VoIP gateway equipment 1A'.

① A measure to discriminate whether or not the companion VoIP gateway equipment 1A' has a common rule for the scramble process to the VoIP gateway equipment 1A

In this measure, the cryptographic-processing-information request section 351 creates a cryptographic-processed-data IP packet, which contains data scrambled by the scramble process, and sends the created cryptographic-processed-data IP packet together with the cryptographic-processing-request IP packet to the companion VoIP gateway equipment 1A'. Further, the cryptographic-processing-information analysis section 353 discriminates whether or not the companion VoIP gateway equipment 1A' has decoded (deciphered) the cryptographic-processed data (the scrambled data) correctly, thereby discriminating whether or not the companion VoIP gateway equipment 1A' has a common rule for the scramble process to the VoIP gateway equipment 1A.

② A measure to discriminate whether or not the companion VoIP gateway equipment 1A' has a common key for the encryption process to the VoIP gateway equipment 1A

In this measure, the cryptographic-processing-information request section 351 creates a cryptographic-processed-data IP packet, which contains data encrypted by the encryption process, and sends the created cryptographic-processed-data IP packet together with the cryptographic-processing-request IP packet to the companion VoIP gateway equipment 1A'. Further, the cryptographic-processing-information analysis section 353 discriminates whether or not the companion VoIP gateway equipment 1A' has deciphered the cryptographic-processed data (the encrypted data) correctly, thereby discriminating whether or not the companion VoIP gateway equipment 1A' has a common key for the encryption process to the VoIP gateway equipment 1A.

③ A measure to discriminate whether or not the companion VoIP gateway equipment 1A' has a common rule for the interleave process to the VoIP gateway equipment 1A

In this measure, the cryptographic-processing-information request section 351 creates a cryptographic-processed-data IP packet, which contains data interleaved by the interleave process, and sends the created cryptographic-processed-data IP packet together with the cryptographic-processing-request IP packet to the

companion VoIP gateway equipment 1A'. Further, the cryptographic-processing-information analysis section 353 discriminates whether or not the companion VoIP gateway equipment 1A' has deciphered the cryptographic-processed data (the interleaved data) correctly, thereby discriminating whether or not the companion VoIP gateway equipment 1A' has a common rule for the interleave process to the VoIP gateway equipment 1A.

By selectively using the above-described measures ①-③, the VoIP gateway equipment 1A, which is incorporated with the communication-status notification apparatus according to the present invention, discriminates whether or not the companion VoIP gateway equipment 1A' can exchange voice data, on which a cryptographic process has been carried out, with the VoIP gateway equipment 1A, namely, whether or not the companion VoIP gateway equipment 1A' has the common rule for the scramble process, the common key for the encryption process and the common rule for the interleave process to the VoIP gateway equipment 1A.

The cryptographic-processing selection/control section 36 controls a cryptographic process carried out by the cryptographic-processing section 34 based on a cryptographic-processing status of the companion VoIP gateway equipment 1A' monitored by the above-described operation of the cryptographic-processing-status monitor section 35.

Concretely, the cryptographic-processing selection/control section 36 chooses a cryptographic process carried out by the cryptographic-processing section 34 so that the cryptographic-processing section 34 carries out the same kind of cryptographic process for voice-data transmission as the cryptographic process which the companion VoIP gateway equipment 1A' is able to carry out.

As described above, according to the VoIP gateway equipment incorporated with the communication-status notification apparatus of the present invention, by carrying out (i) the monitoring/controlling operation of a cryptographic-processing status, (ii) the responding operation to a communication-status request, (iii) the responding operation to a communication-status request and (iv) the monitoring operation of a cryptographic-processing status, the subscriber can control (select, start or stop) the cryptographic-process carried out on voice data in the VoIP gateway equipment connected to the subscriber terminal, and also can perceive the current setting status of the cryptographic process in the VoIP gateway equipment, easily via the subscriber's own terminal.

Further, the subscriber can select cryptographic process to be performed on voice data easily via the subscriber's own terminal, utilizing efficiently the conventional cryptographic processes commonly used in

ordinary data communication such as the scramble process, the encryption process and the interleave process.

Also, the subscriber can perceive cryptographic-processing status in the companion VoIP gateway equipment and a companion subscriber terminal connected to the companion VoIP gateway equipment, and can set the cryptographic process carried out on voice data, easily via the subscriber's own terminal.

In the following description, some expectable services realized by selectively combining the above-described operations (i), (ii), (iii) and (iv) will be described, using an example of a voice call over telephones.

① A service in which a subscriber can set a desired cryptographic process by a DTMF-signal operation during a voice call

First, during a voice call over telephones, a subscriber sends via the subscriber terminal to VoIP gateway equipment a request to select a specific cryptographic process and to start the selected cryptographic process, by carrying out a predetermined DTMF-signal operation.

In the VoIP gateway equipment, on detecting the DTMF signal in the DTMF-signal detection section 14, the request-information analysis section 51 analyzes the content of the request and, when the request turned out to be about selecting a kind of cryptographic process and

processing-status monitor section 35, the communication-status-notification control section 42 controls the interface section 11 to notify the subscriber terminal 2 of a message showing that the selected cryptographic process is not usable and requesting to reselect another kind of cryptographic process.

In response to the message, the subscriber reselects another cryptographic process by a predetermined DTMF-signal operation of the subscriber terminal. When the reselected cryptographic process is usable, the reselected cryptographic process is started according to the above-described procedure.

After the subscriber has selected some kinds of cryptographic processes and when all the selected cryptographic processes are not usable, the communication-status-notification control section 42 controls the interface section 11 to notify the subscriber terminal 2 of a message showing that all the selected cryptographic processes are not usable and that the voice call is continued without any cryptographic processing.

During the voice call with the selected cryptographic process, when the subscriber carries out a predetermined DTMF-signal operation to send a request to reset (cancel) the cryptographic process to the VoIP gateway equipment, the VoIP gateway equipment carries out operation to reset (cancel) the cryptographic process.

Also, it is possible to arrange that when the
subscriber carries out a predetermined DTMF-signal
operation before requesting to select or start the
cryptographic process, the VoIP gateway equipment notify
the subscriber terminal of a message showing a procedure
of setting/selecting operation of the cryptographic
process, variations of cryptographic processes being
selectable, details of safety or a delay time according
to each variation, or the like.

② A service in which the subscriber can set a
desired cryptographic process by a DTMF-signal operation
before a voice call

As a modification of the service ①, it is also
possible to provide another service, in which the
subscriber first makes a call to the VoIP gateway
equipment, connected with the subscriber's terminal,
before a voice call and sends a request to select a
cryptographic process to start the process. Monitoring a
message, sent from the VoIP gateway equipment, regarding
whether or not the companion VoIP gateway equipment is
enable to carry out the selected cryptographic process,
the subscriber can request a voice call with a desired
cryptographic process with specify a companion for the
voice call.

(1-4) Description of Notifying Operation of
Communication Status in the First Embodiment of the
Present Invention:

In the several kinds of operation described above,
(iii) the responding operation to the communication-
status request, described in (1-2) and (1-3), corresponds
to the steps of (a) sending from the subscriber terminal
to the VoIP gateway equipment, connected to the
subscriber terminal, a request on monitoring/controlling
or notifying of a communication status of the IP network,
the request being contained in voice data transmitted
over the IP communication network, and (b) discriminating
at the VoIP gateway equipment whether or not the voice
data received from the subscriber terminal contains the
request sent by the subscriber terminal in the step (a)
and, when the voice data received from the subscriber
terminal contains the request, analyzing the content of
the request contained in the voice data.

Also, (i) the monitoring operation of the traffic
status, described in (1-2), and (i) the
monitoring/controlling operation of a cryptographic-
processing status, described in (1-3), correspond to the
step of (c) monitoring/controlling the communication
status of the IP network based on a processing status of
the voice data in the VoIP gateway equipment in response
to the content of the request analyzed in the step (b).

Further, each (ii) the notifying operation of
communication status, described in (1-2) and (1-3),
corresponds to the step of (d) notifying the subscriber
terminal of the communication status monitored/controlled

in the step (c) in response to the content of the request analyzed in the step (b).

(2) Description of First Modification of the First Embodiment of the Present Invention:

It is also possible to incorporate a VoIP gateway terminal with a communication-status notification apparatus as described in the first embodiment of the present invention.

As the first modification of the first embodiment of the present invention, a VoIP communication system as shown in FIG. 1 including a VoIP gateway terminal 1T, which is incorporated with the communication-status notification apparatus, will be described.

Already referred to in the description of the aspects of the present invention, the VoIP communication system shown in FIG. 1 is again referred to for describing the first modification of the first embodiment of the present invention because of the same reason as that used in the description of the first embodiment of the present invention.

Arrangements of VoIP gateway equipment, being companion of the VoIP gateway terminal 1T for voice-data transmission, and a router, both used in the present modification, are equivalent to the arrangements of the VoIP gateway equipment and the router described in the first embodiment of the present invention. Accordingly, in the following description of arrangements of the

present embodiment, only an arrangement of the VoIP

gateway terminal, incorporated with the communication-

status notification apparatus of the present modification,

will be described.

5   (2-1) Description of Arrangement of the VoIP

Gateway Terminal Incorporated with the Communication-

Status Notification Apparatus of the First Modification:

First, an arrangement of the VoIP gateway terminal,

incorporated with the communication-status notification

10   apparatus of the first modification, will be described

with reference to FIG. 15.

FIG. 15 is a block diagram showing the VoIP gateway

terminal incorporated with the communication-status

notification apparatus according to the first

15   modification of the first embodiment of the present

invention. The VoIP gateway terminal is equivalent to,

for example, the VoIP gateway terminal 1T shown in FIG. 1,

being equipped with both the VoIP-gateway mechanism for

transmitting voice data by converting a voice signal into

20   IP packets, and vice versa, and the subscriber terminal

mechanism for voice communication, and also with a

notification function of communication status according

to the present invention.

Each of components of the VoIP gateway terminal 1T

25   shown in FIG. 15 has the same function as that of the

respective component with the same numeral of the VoIP

gateway equipment shown in FIG. 5 or the subscriber

terminal shown in FIG. 9, with the exception of the following points.

A communication-status-notification control section 42 has a function to control a communication-status display section 28 to display various kinds of information stored in the communication-status storage section 37, such as information about traffic status of the IP network 9 monitored by the traffic-status monitor section 31, information about the communication quality of voice data evaluated by the communication-quality evaluation section 32 and information about the result of the selection/control of the cryptographic processing by the cryptographic-processing selection/control section 36, using the notification materials stored in the notification-material storing section 41.

The communication-status display section 28 has a function to display, under the control by the communication-status-notification control section 42, various kinds of information stored in the communication-status storage section 37, such as information about traffic status of the IP network 9 monitored by the traffic-status monitor section 31, information about the communication quality of voice data evaluated by the communication-quality evaluation section 32 and information about the result of the selection/control of the cryptographic processing by the cryptographic-processing selection/control section 36, using the

notification materials stored in the notification-material storing section 41.

A request-information analyzing section 51 has a function to discriminate whether or not a set of DTMF signals inputted by the subscriber via the DTMF-signal operation circuit 24 includes a DTMF signal corresponding to a request on monitoring/controlling of the communication status from the subscriber terminal and, when there is a DTMF signal corresponding to any request, to analyze the content of the request.

(2-2) Description of Operations of the VoIP Gateway Terminal Incorporated with the Communication-Status Notification Apparatus of the First Modification:

Next, operations in the VoIP communication system according to the first modification the first embodiment of the present invention will be described with reference to FIG. 16.

Operations carried out in the VoIP communication system of the present modification are generally equivalent to the detailed operations (i), (ii), (iii) and (iv) of (1-2) the notifying operation of the traffic status, and the detailed operations (i), (ii), (iii) and (iv) of (1-3) the notifying operation of the cryptographic-processing status, according to the first embodiment of the present invention. In the following, accordingly, only the operations different from the detailed operations of the first embodiment will be

described.

As shown in FIG. 16, a VoIP gateway terminal 1T and two sets of VoIP gateway equipment 1', 1'' are connected to an IP network 9, which includes a router 90. The VoIP gateway terminal 1T is incorporated with the communication-status notification apparatus of the present invention, which apparatus has the arrangement as shown in FIG. 15. Each of the sets of VoIP gateway equipment 1', 1'' is incorporated with the communication-status notification apparatus of the present invention, which apparatus has the arrangement as shown in FIG. 5. One set of VoIP gateway equipment 1' is also connected with a subscriber terminal 2'.

The following description is concentrated on operations by the VoIP gateway terminal 1T.

When the VoIP gateway terminal 1T requests the router 90 in the IP network 9 or VoIP gateway equipment 1' connected to the IP network 9 to notify of information about the traffic status or information about the cryptographic-processing status, the VoIP gateway terminal 1T itself exchanges IP packets between the object router 90 or the VoIP gateway equipment 1' (Steps A'1, A'2, Steps B'1, B'2). The Steps A'1, A'2 and the Steps B'1, B'2 in FIG. 16 correspond to the Steps A1, A2 and the Steps B1, B2 shown in FIG. 11, respectively.

In the meantime, the VoIP gateway terminal 1T is used by a personal subscriber, there is a possibility

that the details of the VoIP gateway terminal are
identified by the VoIP gateway equipment 1' or the
subscriber terminal 2' connected to the VoIP gateway
equipment 1', being a companion for voice transmission.

5   Accordingly, when the VoIP gateway terminal 1T
carries out any monitoring/controlling operation of the
network having a possibility that the details of the VoIP
gateway terminal 1T are identified by other equipment or
another terminal, the VoIP gateway terminal 1T requests

10   other VoIP gateway equipment 1'' to carry out the desired
monitoring/controlling operation of the communication
status (Steps X1 and X2), so that the requested VoIP
gateway equipment 1'' carry out the desired
monitoring/controlling operation of the communication

15   status in behalf of the VoIP gateway terminal 1T (Steps
A''1 and A''2, Steps B''1 and B''2). Also the Steps A''1,
A''2 and the Steps B''1, B''2 in FIG. 16 correspond to
the Steps A1, A2 and the Steps B1, B2 shown in FIG. 11,
respectively.

20   (3) Description of Second Modification of the First
Embodiment of the Present Invention:

          As described above, the communication-status
notification apparatus described in the first embodiment
of the present invention, which is capable of

25   monitoring/controlling or notifying two kinds of
communication status in an IP network as specific aspects
of the communication status, namely, the traffic status

-118-

in an IP network and the cryptographic-processing status of voice data.

It is also possible to provide a communication-status notification apparatus which is equipped with only components related with one of the two kinds of communication status, thereby still enabling to monitor/control or notify of the one kind of communication status.

The following description will be first made on, as the second modification of the first embodiment of the present invention, a VoIP communication system as shown in FIG. 1 including VoIP gateway equipment 1A, which is incorporated with a communication-status notification apparatus having an arrangement for monitoring/controlling or notifying of only the traffic status in the IP network.

Already referred to in the description of the aspects of the present invention, the VoIP communication system shown in FIG. 1 is again referred to for describing the present modification because of the same reason as that used in the description about the first embodiment of the present invention.

Arrangements of VoIP gateway equipment, being companion of the VoIP gateway equipment 1A for voice-data transmission, and a router, both used in the present modification, are equivalent to the arrangements of the VoIP gateway equipment and the router described in the

first embodiment of the present invention. Accordingly, in the following description, only an arrangement of the VoIP gateway equipment 1A incorporated with the communication-status notification apparatus of the present modification will be described.

(3-1) Description of Arrangement of the VoIP Gateway Equipment Incorporated with the Communication-Status Notification Apparatus of the Second Modification:

First, an arrangement of the VoIP gateway equipment, incorporated with the communication-status notification apparatus of the second modification, will be described with reference to FIG. 17.

FIG. 17 is a block diagram showing the VoIP gateway equipment incorporated with the second modification of the first embodiment of the present invention. The VoIP gateway equipment shown in FIG. 17 is equivalent to, for example, the VoIP gateway equipment 1A shown in FIG. 1, being equipped with the VoIP-gateway mechanism for transmitting voice data by converting a voice signal into IP packets, and vice versa, and also with a notification function of traffic status according to the present invention.

Each of components of the VoIP gateway equipment 1A shown in FIG. 17 has the same function as that of the respective component with the same numeral of the VoIP gateway equipment shown in FIG. 5.

(3-2) Description of Operations of the VoIP Gateway

Equipment Incorporated with the Communication-Status
Notification Apparatus of the Second Modification:

Next, operations in the VoIP communication system
according to the second modification of the first
embodiment of the present invention will be described.

Operations carried out in the VoIP communication
system of the present modification are generally
equivalent to the detailed operations (i), (ii), (iii)
and (iv) of (1-2) the notifying operation of the traffic
status, of the first embodiment of the present invention.

With such a simpler arrangement than that of the
communication-status notification apparatus of the first
embodiment arrangement, it is possible to realize the
function of monitoring/controlling and notifying the
traffic status of the IP network.

(4) Description of Third Modification of the First
Embodiment of the Present Invention:

Next, as the third modification of the first
embodiment of the present invention, a VoIP communication
system as shown in FIG. 1, including VoIP gateway
equipment 1A, which is incorporated with a communication-
status notification apparatus having an arrangement for
monitoring/controlling or notifying of only the
cryptographic-processing status of the voice data, will
be described.

Already referred to in the description of the
aspects of the present invention, the VoIP communication

system shown in FIG. 1 is again referred to for describing the present modification because of the same reason as that used in the description about the first embodiment of the present invention.

5   Arrangements of a subscriber terminal and a router both used in the present modification are equivalent to the arrangements of the subscriber terminal and the router described in the first embodiment of the present invention. Accordingly, in the following description of

10   arrangements of the present embodiment, only an arrangement of the VoIP gateway equipment 1A, incorporated with the communication-status notification apparatus of the present modification, will be described.

       (4-1) Description of Arrangement of the VoIP

15   Gateway Equipment Incorporated with the Communication-Status Notification Apparatus of the Third Modification:

       First, an arrangement of the VoIP gateway equipment, incorporated with the communication-status notification apparatus of the third modification, will be described

20   with reference to FIG. 18.

       FIG. 18 is a block diagram showing the VoIP gateway equipment incorporated with the communication-status notification apparatus according to the third modification of the first embodiment of the present

25   invention. The VoIP gateway equipment shown in FIG. 18 is equivalent to, for example, the VoIP gateway equipment 1A shown in FIG. 1, being equipped with the VoIP-gateway

mechanism for transmitting voice data by converting a voice signal into IP packets, and vice versa, and also with a notification function of cryptographic-processing status according to the present invention.

Each of components of the VoIP gateway equipment 1A shown in FIG. 18 has the same function as that of the respective component with the same numeral of the VoIP gateway equipment shown in FIG. 5.

(4-2) Description of Operations of the VoIP Gateway Equipment Incorporated with the Communication-Status Notification Apparatus of the Third Modification:

Next, operations in the VoIP communication system according to the third modification of the first embodiment of the present invention will be described with reference to FIG. 19.

Operations carried out in the VoIP communication system of the present modification are generally equivalent to the detailed operations (i), (ii), (iii) and (iv) of (1-3) the notifying operation of cryptographic-processing status, of the first embodiment of the present invention.

The following description will be made on detailed processes carried out by the VoIP gateway equipment on a voice signal received from a subscriber terminal or an IP packet received from the IP network.

Receiving a voice signal from the subscriber terminal, the VoIP gateway equipment first detects a DTMF

signal included in the voice signal (I1), and carries out
voice-addition/level-control process on the voice signal
(I2) as preprocessing. Next, the VoIP gateway equipment
sets an appropriate cryptographic process on

5   (cryptographic-processes) the preprocessed voice signal
(I3). Then, the VoIP gateway equipment compresses the
cryptographic-processed voice signal into voice data
according to the audio CODEC (I4), and IP-packetizes
(makes an IP packet containing) the compressed voice data

10   (I5), so as to send the created IP packet over the IP
network toward a companion gateway or terminal (I6).

On the other hand, receiving an IP packet from the
IP network, the VoIP gateway equipment first depacketizes
the IP packet to extract cryptographic-processed voice

15   data contained in the IP packet (J1) and resets the
appropriate cryptographic process set on the voice data
(decodes the cryptographic-processed voice data) (J2).
Next, the VoIP gateway equipment decompresses the decoded
voice data into a voice signal according to the audio

20   CODEC (J3) and carries out voice-addition/level-control
process on the voice signal (J4), so as to send the
resultant voice signal to the subscriber terminal.

Although the order of the compression/decompression
process and the set/reset process of cryptographic

25   process as shown in FIG. 19 is contrary to the order of
the corresponding processes according to the arrangement
of the first embodiment of the present invention as shown

in FIG. 5, it is noted that either order is practically possible and therefore does not affect the gist of the present invention.

Further, on detecting any DTMF signal included in the voice signal received from the subscriber terminal, the VoIP gateway equipment discriminates whether or not the DTMF signal corresponds to a request on selecting, controlling or notifying of the cryptographic process and, when the DTMF signal corresponds to any request, analyzes the content of the request, so as to control the voice-addition/level-control process or the setting of the cryptographic process in response to the content of the request (K1).

Also, by controlling a voice signal to be sent to the subscriber terminal in response to a request on monitoring/controlling or notifying of the cryptographic-processing status from the subscriber terminal, the cryptographic-processing status is notified to the subscriber terminal (K2).

With such a simple arrangement than that of the communication-status notification apparatus of the first embodiment arrangement, it is possible to realize the function of monitoring/controlling and cryptographic-processing status on voice data.

(5) Description of the Fourth Modification of the First Embodiment of the Present Invention:

As described above, the communication-status

notification apparatus described in the first embodiment
of the present invention, which has the communication-
status monitor/control section 30, the communication-
status notification section 40 and the request analysis

5   section 50.

It is also possible to provide a communication-
status notification apparatus which is equipped with only
the communication-status monitor/control section 30 and
the communication-status notification section 40, thereby

10   still enabling to monitor/control or notify of the
communication status.

The following description will be made on, as the
fourth modification of the first embodiment of the
present invention, a VoIP communication system as shown

15   in FIG. 1 including VoIP gateway equipment 1A, which is
incorporated with a communication-status notification
apparatus having only a communication-status
monitor/control section and a communication-status
notification section.

20   Already referred to in the description of the
aspects of the present invention, the VoIP communication
system shown in FIG. 1 is again referred to for
describing the present modification because of the same
reason as that used in the description about the first

25   embodiment of the present invention.

Arrangements of a subscriber terminal and a router
both used in the present modification are equivalent to

the arrangements of the subscriber terminal and the
router described in the first embodiment of the present
invention. Accordingly, in the following description,
only an arrangement of the VoIP gateway equipment,
incorporated with the communication-status notification
apparatus of the present modification, will be described.

(5-1) Description of Arrangement of the VoIP
Gateway Equipment Incorporated with the Communication-
Status Notification Apparatus of the Fourth Modification:

First, an arrangement of the VoIP gateway equipment,
incorporated with the communication-status notification
apparatus of the fourth modification, will be described
with reference to FIG. 20.

FIG. 20 is a block diagram showing the VoIP gateway
equipment incorporated with the fourth modification of
the first embodiment of the present invention. The VoIP
gateway equipment shown in FIG. 20 is equivalent to, for
example, the VoIP gateway equipment 1A shown in FIG. 1,
being equipped with the VoIP-gateway mechanism for
transmitting voice data by converting a voice signal into
IP packets, and vice versa, and also with a notification
function of communication status (such as a traffic
status and a cryptographic-processing status) according
to the present invention.

Each of components of the VoIP gateway equipment 1A
shown in FIG. 20 has the same function as that of the
respective component with the same numeral of the VoIP

-127-

gateway equipment shown in FIG. 5.

In other words, the VoIP gateway equipment 1A shown in FIG. 20 has the arrangements equivalent to the communication-status monitor/control section 30 and the communication-status notification section 40 of VoIP gateway equipment 1A shown in FIG. 5.

In order to incorporate VoIP gateway equipment with the functions of the communication-status monitor/control section 30 and the communication-status notification section 40, a recording medium in which a communication-status notification program and associated data are recorded is usually provided and the program and the associated data are installed in the VoIP gateway equipment. The communication-status notification program instructs the computer to function as: communication-status monitoring/controlling means for the same function as the communication-status monitor/control section 30 (which means has a function to monitor/control the communication status of the IP network 9, based on the processing status of the voice data in the VoIP gateway equipment); and communication-status notifying means for the same function as the communication-status notification section 40 (which means has a function to notify the subscriber terminal of the communication status, which is monitored/controlled by the monitoring/controlling means, via the VoIP gateway equipment).

The installation of the program and the associated data is performed by setting a storing medium, such as a floppy disk, an MO (Magneto-Optic) disk, a CD-ROM (compact disk read-only memory), a hard disk or any other various storing apparatuses, in the computer, or by using a program provided through the IP network.

(5-2) Description of Operations of the VoIP Gateway Equipment Incorporated with the Communication-Status Notification Apparatus of the Fourth Modification:

Next, operations in the VoIP communication system according to the fourth modification of the first embodiment of the present invention will be described.

Operations carried out in the VoIP communication system of the present modification are generally equivalent to the detailed operations (i), (ii), (iii) and (iv) of (1-2) the notifying operation of the traffic status, and the detailed operations (i), (ii), (iii) and (iv) of (1-3) the notifying operation of the cryptographic-processing status, according to the first embodiment of the present invention. By excluding the functions responsive to a request from the subscriber terminal, it is possible to realize the VoIP gateway equipment for voluntarily monitoring/controlling and notifying the communication status of the IP network, with such a simpler arrangement than that of the communication-status notification apparatus of the first embodiment.

The detailed operations (i) and (ii), each
described in both (1-2) and (1-3), respectively
correspond to the steps of (a) monitoring/controlling the
communication status of the IP network based on a

5   processing status of the voice data in the VoIP gateway
equipment, and (b) notifying the subscriber terminal of
the communication status monitored/controlled in the step
(a).

(5-3) Description of Variation of the Fourth
10 Modification of the First Embodiment of the Present
Invention:

As described above, the communication-status
notification apparatus described in the fourth
modification of the first embodiment of the present
15 invention has the communication-status monitor/control
section 30 and the communication-status notification
section 40.

Practically, it is also possible to provide a
communication-status notification apparatus which is
20 equipped with only a communication-status-notification
management section 3&4, thereby enabling to simply notify
of the communication status.

The following description will be made on, as a
variation of the fourth modification of the first
25 embodiment of the present invention, a VoIP communication
system as shown in FIG. 1 including VoIP gateway
equipment 1A, which is incorporated with a communication-

status notification apparatus having only a
communication-status-notification management section.

Already referred to in the description of the
aspects of the present invention, the VoIP communication
5   system shown in FIG. 1 is again referred to for
describing the present modification because of the same
reason as that used in the description about the first
embodiment of the present invention.

Arrangements of a subscriber terminal and a router,
10   both used in the present modification, are equivalent to
the arrangements of the subscriber terminal and the
router described in the first embodiment of the present
invention. Accordingly, in the following description of
arrangements of the present embodiment, only an
15   arrangement of the VoIP gateway equipment 1A incorporated
with the communication-status notification apparatus of
the present modification will be described.

The VoIP gateway equipment with the communication-
status notification apparatus according to the variation
20   of the fourth modification of the first embodiment of the
present invention has an arrangement similar to the
arrangement of VoIP gateway equipment according to the
fourth modification of the first embodiment of the
present invention with the exception of the following
25   points.

The communication-status monitor/control section 30
of the fourth modification of the first embodiment of the

- 131 -

present invention is excluded from the VoIP gateway
equipment of the present modification.

The communication-status-notification management
section has the components equivalent to those of the
communication-status notification section 40 of the
fourth modification of the first embodiment of the
present invention, with the exception that the
communication-status-notification control section 42 of
the communication-status-notification management section
further has a function of controlling the IP-packet
creation/analysis section 13 to monitor a
sending/receiving status of IP packets to/from the IP
network 9 and a creating/analyzing status of IP packets,
and a function of analyzing the communication status in
the IP network 9 based on the sending/receiving status of
IP packets to/from the IP network 9 and the
creating/analyzing status of IP packets.

With this arrangement, the VoIP gateway equipment
with the communication-status notification apparatus
according to the present variation carries out the
following operations.

First, the communication-status-notification
control section 42 controls the IP-packet
creation/analysis section 13 to monitor a
sending/receiving status of IP packets to/from the IP
network 9 and a creating/analyzing status of IP packets.

Then, the communication-status-notification control

- 132 -

section 42 analyzes the communication status in the IP

network 9 based on the sending/receiving status of IP

packets to/from the IP network 9 and the

creating/analyzing status of IP packets, so as to control

5   the interface section 11 to notify the subscriber

terminal of the analyzed communication status.

(6) Description of the Fifth Modification of the

First Embodiment of the Present Invention:

Finally, as the fifth modification of the first

10   embodiment of the present invention, a VoIP communication

system as shown in FIG. 1 including the subscriber

terminal 1B, which is incorporated with the

communication-status display apparatus according to the

present invention, will be described.

15   Already referred to in the description of the

aspects of the present invention, the VoIP communication

system shown in FIG. 1 is again referred to for

describing the fifth modification of the first embodiment

of the present invention because of the same reason as

20   that used in the description about the first embodiment

of the present invention.

An arrangement of a router used in the present

modification is equivalent to the arrangement of the

router described in the first embodiment of the present

25   invention. Accordingly, in the following description of

arrangements of the present embodiment, only arrangements

of the subscriber terminal, incorporated with the

communication-status display apparatus of the present

modification, and the VoIP gateway equipment,

incorporated with the communication-status notification

apparatus of the present modification and used with the

subscriber terminal, will be described.

(6-1) Description of Arrangement of the VoIP

Gateway Equipment Incorporated with the Communication-

Status Notification Apparatus of the Fifth Modification:

First, an arrangement of the VoIP gateway equipment,

incorporated with the communication-status notification

apparatus of the fifth modification, will be described

with reference to FIG. 5.

The VoIP gateway equipment used in the present

modification has an arrangement basically equivalent to

the VoIP gateway equipment described in the first

embodiment of the present invention with reference to FIG.

5, being incorporated with a VoIP-gateway mechanism and

the notification function of the communication status

according to the present invention.

Differences between the VoIP gateway equipment used

in the present modification and the VoIP gateway

equipment of the first embodiment is as follows.

In the VoIP gateway equipment used in the present

modification, the communication-status-notification

control section 42 has a function to monitor a voice

signal which undergoes the input/output process by the

interface section 11, thereby discriminate whether or not

-134-

a subscriber terminal 2A connected to the interface section 11 is the subscriber terminal 2A incorporated with the communication-status display apparatus according to the present modification.

Further, the communication-status-notification control section 42 is arranged to function as, when the subscriber terminal 2A connected to the interface section 11 is judged to be the subscriber terminal 2A incorporated with the communication-status display apparatus according to the present modification, controlling directly the interface section 11 to send to the subscriber terminal 2A display control information, which causes the subscriber terminal 2A to display the information stored in the communication-status storage section 37, in the form of a voice signal, without using the notification materials stored in the notification-material storing section 41.

(6-2) Description of Arrangement of the Subscriber Terminal Incorporated with the Communication-Status Display Apparatus of the Fifth Modification:

Next, an arrangement of the subscriber terminal, incorporated with the communication-status display apparatus of the fifth modification of the present invention, will be described with reference to FIG. 21.

FIG. 21 is a block diagram showing an arrangement of the subscriber terminal incorporated with the communication-status display apparatus according to the

present invention. The subscriber terminal is equivalent to, for example, the subscriber terminal 2A shown in FIG. 1, being connected to the VoIP gateway equipment 1A with the communication-status notification apparatus according to the present invention via a telecommunication network, such as a PSTN or a ISDN, or an exchange, or directly.

The subscriber terminal 2A includes components to serve as a conventional voice communication function: a voice transmission circuit 21, a voice-data input section 22, a voice-data output section 23, a DTMF-signal control circuit 24 and a call notifying means 25. Each of these components has the same function as that of a respective component with the same numeral of the subscriber terminal shown in FIG. 9.

In addition to the components for a voice communication function, the subscriber terminal 2A includes components to serve as a function of the communication-status display apparatus according to the present invention, a notification-information detection section 26, a display-material storage section 27 and a communication-status display section 28.

The notification-information detection section 26 detects display control information, which was sent from the VoIP gateway equipment 1A, out of voice signals sent from the VoIP gateway equipment 1A and received by the subscriber terminal 2A.

The display-material storage section 27 stores at

least one of voice, character and image, which represents information about communication status corresponding to the display control information sent from the VoIP gateway equipment 1A, as display materials used for the communication-status display section 28.

The communication-status display section 28 displays information about the communication status of the IP network 9 notified of from the VoIP gateway equipment 1A, using the display materials stored in the display-material storage section 27, in response to the display control information detected by the notification-information detection section 26.

With the arrangement as described above, the notification-information detection section 26 functions as a notified-information detection section for detecting information about the communication status of the IP network 9, which status is monitored/controlled by the VoIP gateway equipment 1A, when the subscriber terminal 2A is notified of the communication-status information from the VoIP gateway equipment 1A, the display-material storage section 27 functions as a display-material storage section for storing at least one of voice, character and image as display materials, and the communication-status display section 28 functions as a communication-status display section for displaying the communication status of the IP network 9, based on the communication-status information detected by the

- 137 -

notified-information detection section, using the display
materials stored in the display-material storage section.

(6-3) Description of Operations in the VoIP
Communication System According to the Fifth Modification:

Next, operations in the VoIP communication system
according to the fifth modification of the first
embodiment of the present invention will be described.

Operations carried out in the VoIP communication
system of the present modification are generally
equivalent to the detailed operations (i), (ii), (iii)
and (iv) of (1-2) the notifying operation of the traffic
status, and the detailed operations (i), (ii), (iii) and
(iv) of (1-3) the notifying operation of the
cryptographic-processing status, according to the first
embodiment of the present invention. In the following,
accordingly, only some operations different from the
detailed operations of the first embodiment will be
described.

In the VoIP communication system of the present
modification, the above (ii) notifying operation of the
communication status is performed according to the
following procedure.

First, in the VoIP gateway equipment 1A, when the
communication-status-notification control section 42
confirms that the subscriber terminal 2A connected to
VoIP gateway equipment 1A is incorporated with the
communication-status display apparatus according to the

present embodiment, the communication-status-notification

control section 42 controls the interface section 11 to

send to subscriber terminal 2A display control

information, which causes the subscriber terminal 2A to

5   display the information stored in the communication-

status storage section 37, in the form of the voice

signal.

In the subscriber terminal 2A, the notification-

information detection section 26 detects the display

10   control information, which was sent from the VoIP gateway

equipment 1A via the voice transmission circuit 21, out

of voice signals sent from the VoIP gateway equipment 1A

and received by the subscriber terminal 2A.

Next, the communication-status display section 28

15   displays information about the communication status of

the IP network 9 notified of from the VoIP gateway

equipment 1A, using the display materials stored in the

display-material storage section 27, in response to the

display control information detected by the notification-

20   information detection section 26.

The notification-information detection section 26

carries out an operation to detect the display control

information selectively in the three manners, according

to a condition of voice communication and a kind of the

25   communication status: continuously, at regular intervals,

and in response to an instruction by the subscriber.

By performing the above-described operations, since

the communication status notified of from the VoIP

gateway equipment 1A is displayed on the subscriber

terminal 2A, the subscriber can easily and clearly

perceive various kinds of communication status of the IP

5 network 9.

If the VoIP communication system includes only the

subscriber terminals each incorporated with the

communication-status display apparatus according to the

present modification, the VoIP gateway equipment 1A does

10 not need to confirm a kind of the subscriber terminal 2A.

It is therefore possible to provide a VoIP communication

system in which the VoIP gateway equipment 1A notify the

subscriber terminal of the communication-status always

using the display control information. In the VoIP

15 communication system, the VoIP gateway equipment 1A is

not equipped with the notification-material storing

section 41, and arranged so that the communication-

status-notification control section 42 notifies the

subscriber terminal of the communication-status always

20 using the display control information.

(7) Others

In the above-described embodiment and modifications,

the description has been made on the communication-status

notification apparatus according to the present invention

25 which monitors/controls or notifies the traffic status of

voice data and/or the cryptographic-processing status on

voice data as examples of the communication status in an

IP network.

Needless to say, the communication-status notification apparatus according to the present invention is also applicable to monitor/control and notify other various kinds of communication status.

Other examples are the followings.

① Arrangement to Monitor and Notify Breakdown Status in IP Network as Communication Status

In this arrangement, the VoIP gateway equipment incorporated with the communication-status notification apparatus according to the present invention requests a router connected to the VoIP gateway equipment that, when a breakdown occurs in a part of IP network connected to the router and disables the router for transmitting IP packets along a path passing through the broken-down part, the router informs the VoIP gateway equipment of the disability.

With the above-described arrangement, the communication-status notification apparatus according to the present invention is able to monitor a breakdown status in the network and to notify the subscriber terminal of the monitored breakdown status, regarding not only a breakdown occurring in a network area directly connected to the VoIP gateway equipment, but also a network area indirectly connected to the VoIP gateway equipment via the router.

② Arrangement to Monitor and Notify the Number of

Connections Established in IP Network

In this arrangement, the VoIP gateway equipment incorporated with the communication-status notification apparatus according to the present invention requests a router connected to the VoIP gateway equipment to monitor a destination of each voice packet transmitted through the router and to inform the VoIP gateway equipment of the monitored destination.

With the above-described arrangement, the communication-status notification apparatus according to the present invention is able to calculate the number of connections established in the IP network and to notify the subscriber terminal of the calculated number of connections.

Either of the arrangements ① and ② is realized using substantially the same VoIP gateway equipment as that according to the first embodiment. Concretely, both of the breakdown status in an IP network and the number of connections established in an IP network is monitored using the router-information request section 311, the router-information obtaining section 312 and the router-information analysis section 313 of the VoIP gateway equipment of the first embodiment.

Obviously, the present invention is not limitedly applicable to the VoIP system, but is generically applicable to various other kinds of communication system.

The present invention is not limited to the above-

mentioned embodiment and modifications, but is generally

applicable with various modifications unless deviating

the gist of the present invention.

5